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PRIVATIZATION OF UTILITIES IN GOVERNMENT OWNED HOUSING: A MODEL APPROACH

by

James L. Autrey

June 1997

Principal Advisor: Shu S. Liao

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1. AGENCY USE ONLY *(Leave Blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	June 1997	Master's Thesis

4. TITLE AND SUBTITLE: **PRIVATIZATION OF UTILITIES IN GOVERNMENT OWNED HOUSING: A MODEL APPROACH**	5. FUNDING NUMBERS
6. AUTHOR(S) James L. Autrey	
7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the United States Government.

12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.	12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

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After validating the forecasting models and comparing costs under the UHA concept, this study concludes that the UHA concept would save approximately $268,300 annually at LMV alone. Additionally, in meeting the Navy's Year 2005 goal of reducing energy consumption by 30% per square foot, by implementing an UHA concept, the projected savings in LMV alone are approximately 50% per square foot/month. Although the study focuses on LMV, it is assumed that similar energy inefficiencies are being demonstrated in other NFH areas. Therefore, this study provides the necessary steps to conduct comparative analysis in other NFH areas.

14. SUBJECT TERMS Utilities, Navy Family Housing, Privatization, Electric Utilities, Gas Utilities	15. NUMBER OF PAGES **100**
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18 298-102

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PRIVATIZATION OF UTILITIES IN GOVERNMENT OWNED HOUSING: A MODEL APPROACH

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B.B.A., University of Oklahoma, 1986

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
June 1997

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This thesis examines the option of privatizing electricity and gas utilities, requiring residents of Navy Family Housing (NFH) to pay for all consumption. To assist in the payment, an Utility Housing Allowance (UHA) would be provided to residents based on the average consumption of local Private Sector Housing (PSH) residents. The goal of this thesis is to determine if implementing an UHA would reduce the overall energy consumption in NFH. Specifically, it determines the historical usage of electricity and gas in the Naval Postgraduate School's La Mesa housing village (LMV) area and the local PSH areas. It then develops forecasting models for both areas to predict the future consumption of utilities, sets a baseline consumption rate for LMV residents, and identifies the savings that would be generated from implementing the UHA program.

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I. INTRODUCTION AND PROBLEM BACKGROUND

A. INTRODUCTION

The Department of the Navy has a defined energy strategy to reduce energy costs, reduce petroleum fuel usage, and increase use of renewable energy. Specifically, three major program goals are to:

- Reduce energy consumption per square foot by 30 percent by the year 2005 (relative to 1985) without compromising military readiness, sustainability, quality of life and safety.
- Train all shore facility energy managers.
- Implement, to the maximum extent practical, all shore facility energy projects with a payback of less than ten years. (Naval Facilities Engineering Service Center, 1996, pp. 1-7)

In view of this aggressive plan to reduce overall energy consumption by 30 percent per square foot by the year 2005, the Navy must aggressively look at all energy users.[1] Some users that could provide significant energy savings are the residents of Navy Family Housing (NFH).

In two Navy fleet concentration areas (San Diego, CA and Tidewater, VA areas), the Navy manages approximately 12,317 NFH (Naval Facilities Engineering Command, Western Division, 1996, p. 1). Because the Navy pays all energy-related bills, there are generally no monitoring devices or programs to provide incentives to save.

Therefore, residents of NFH have no incentives to reduce overall consumption and can, essentially, use as much energy as they desire.[2] In private sector housing (PSH), residents can also use, as much energy as they desire,

---

[1]A "user" is defined as any organization or individual that uses gas and electric utilities.

[2]Navy energy programs do exist for NFH residents, however these programs are in the form of "energy awareness" vice energy compliance. Additionally, often these programs are only administered by posting bulletins and passing out flyers. Monitoring devices are installed in some NFH, however in most areas these meters are generally not utilized effectively in an overall energy conservation program.

however, there is an incentive for these individuals to reduce their overall energy consumption. Since PSH residents must pay for all energy consumed, given a finite level of resources, most will employ an energy reduction program to reduce overall energy cost.

This thesis examines the potential energy savings that could be achieved by creating incentives for residents of NFH to reduce overall energy consumption. It will focus on potential energy savings that could be achieved by paying residents of NFH a forecasted amount (based on PSH consumption) to pay energy bills directly to the energy provider. Once residents of NFH are given a fixed dollar amount for utilities, they will have essentially one of two options:

- Pay additional costs (out of pocket) for going over the predetermined rate.
- Reduce overall energy consumption to either break-even or gain monetarily from benefits of reduction.

Although residents of NFH forfeit all housing allowances once they move in, an Utilities Housing Allowance (UHA) would be generated from a forecasting model to create an incentive to reduce overall energy consumption. The forecasted allowance is based on the average consumption used by PSH residents. The forecasting model examines the electrical and gas consumption behavior of PSH residents and then compares it to the consumption pattern of NFH residents.

Specifically, the model addresses consumption patterns of Naval Postgraduate School (NPS) NFH residents and PSH residents in the same geographical area. The thesis provides steps to implement similar models in other Navy housing areas.

B. GENERAL COMPLICATING FACTORS

Determination of energy consumption patterns for individual NFH residents and forecasting a baseline usage rate is complicated due to a number of general factors. A discussion of these factors follows.

1. Individual NFH Units Are Not Metered

NPS has approximately 877 NFH units of various sizes.[3] Single master meters for gas and electricity monitor all electricity and gas consumed by these units. Therefore, it is impossible to precisely determine energy consumption by each individual unit.

2. NFH Units Not Are Constructed the Same

NPS manages various units including single family, duplex, triplex, apartment, and townhouse dwellings. Because of this diversity in construction, each home will consume different amounts of energy. Additionally, many homes are being upgraded periodically throughout the year so even units of the same type are not identical.

3. Numbers of Occupants Vary in Individual NFH Units

Assignment of NFH is not dependent on size of individual families.[4] Consequently, the number of occupants in each household varies. It is intuitive to expect smaller families to consume less energy.

4. There is Often a Time Lag Between Consumption and Billing

Many times it is difficult to determine monthly consumption of electricity and gas due to late billing by the vendor.[5] This complicates the implementation of an accurate forecasting model due to large variations of consumption from one month to the next. To overcome this problem, estimates based on historical

---

[3]NPS NFH units vary in size from 811 SQ FT to 1622 SQ FT.

[4]To be assigned NFH, the occupant must be a member of the armed forces and married.

[5]Vendor in this situation refers to Pacific Gas and Electric (PG&E) the provider of gas and electric utilities to La Mesa Housing Complex.

records are generally used. The data are therefore not sufficiently accurate for development of a forecasting model.

5. **There are Large Variations in PSH Sizes**

In developing an accurate forecasting model, the average size PSH must be determined in order to allow comparison to NFH. The Monterey Peninsula governmental agencies do not collect this statistical data. Information must be gathered from local realtors who have historical sales records. In order to generate the average size of PSH, a representative sample of home sizes sold in the local area was computed.

6. **NFH Units and PSH Units Are Not Constructed the Same**

The difference in housing construction among NFH units is similar to the differences between NFH units and PSH units. The differences are not only in size of units, but also include type of construction, number of residents and location. It is not feasible to accurately determine the size, energy efficiency, and number of occupants of each PSH unit in the local area. Assumptions and estimates from available data were used in determining a forecasting model.

C. SPECIFIC FACTORS WITH RESPECT TO ELECTRICITY AND GAS

Although the primary scope of this study focuses on usage, certain cost factors that complicate implementation of an incentive plan must be discussed. These include the following factors:

1. **Multiple Electric Rate Structures**

Pacific Gas and Electric (PG&E) charges multiple rates for its various residential customers depending on geographical location. There are four residential rates that PG&E charges its customers, based on the type of service that is provided, to the Monterey Peninsula area. NPS is charged under two of these

rates, while a majority of PSH residents (in the Monterey area) are charged under the other two rates. The four rate schedules are summarized below:

2. **Special Electricity Schedule for La Mesa Housing**

La Mesa housing complex is charged a negotiated contract price for electrical service. This fee is a combination of industrial rates and residential rates. The monthly charge for service under this contract is the sum of customer charges, demand charges and energy charges (Murdter, 1994, p. 9):

- The customer charge is a flat monthly fee per meter
- There are three demand charges, a maximum peak period demand charge, a maximum partial-peak period demand charge and a maximum demand charge. The maximum peak period demand charge per kilowatt-hour[6] applies to the maximum demand during the month's peak hours. The maximum partial-peak period demand charge applies to the maximum demand during the month's partial-peak hours. Finally, the maximum demand charge applies to the maximum demand at any time during the month. The bill includes all three of these demand charges.
- The energy charge is the sum of the energy charges from the peak, partial-peak, and off-peak periods. NPS pays for energy by the kilowatt-hour, and rates differ according to time of day and time of year.

3. **Schedule GM Master-Metered Multifamily Service**

This schedule includes gas services supplied to multifamily accommodations through one master meter where all the accommodations are not separately sub-metered. Gas charges under this schedule are broken down as follows:

- At or below baseline quantity, per therm[7] is charged $0.63966 per meter, per month.

---

[6]Kilowatt-hour (kWh) is equal to 1000 watts of electrical usage. NPS reports all usage in Megawatt-hours (1,000,000 watt-hours).

[7]Natural gas is measured in therms, which are units of heat (1 therm = 100,000 BTUs), instead of by volume because the heat content of gas per unit of volume varies. NPS reports all gas usage in MBTUs

- In excess of baseline quantities, per therm is charged $0.86354 per meter, per month.
- Baseline quantities for the Monterey area are .7 therms per day or 1.4 therms per day, according to time of year (summer or winter respectively).

4. **Schedule E-1 Residential Service**

Includes electric services provided to single-family dwellings and to flats and apartments separately metered by PG&E. Charges include:

- At or below baseline quantities, per kWh is charged $0.11589, per meter, per month.
- In excess of baseline quantities, per kWh is charged $0.13321, per meter, per month.
- Baseline quantities for the Monterey area are 7.7 kWh per day or 8.9 kWh per day, according to time of year (summer or winter respectively).

5. **Schedule G-1 Residential Service**

Includes gas services provided to individually metered single family premises and to separately metered common areas in multifamily complexes. A summary of G-1 schedule includes the following charges:

- Same baseline charge as GM schedule
- Baseline quantities for the Monterey area are .7 therms per day or 1.9 therms per day, according to time of year (summer or winter respectively).

In summary, electrical rates differ significantly between NFH and PSH, however, gas rates only differ by the baseline amounts. These differences (both gas and electrical), will become important when conducting a cost benefit analysis of creating an incentive system for NFH occupants. Assumptions about future rate schedules must be speculated.

(1,000,000 BTUs). Data that is provided by PG&E is measured in Decatherms (1,000,000 BTUs). Therefore, for conversion purposes, 1MBTU=1Decatherm.

D. THESIS OBJECTIVES AND METHODOLOGY

The Navy has set a goal of reducing energy consumption by 30 percent per square foot by 2005. This is especially important during a time of reduced resources within the Department of the Navy's budget. By creating a realistic incentive system to reduce energy usage, the Department of the Navy can achieve significant reductions in energy related costs. The proposed incentive system shifts the responsibility of energy conservation to the occupants vice the Command that manages NFH. This thesis will attempt to determine if any savings can be achieved by privatizing utilities in NFH.

The first objective is to sample PSH in two different cities within the same geographical area to determine average gas and electrical consumption rates. The second objective will be to determine the average gas and electrical consumption rates for NFH. The third objective will be to analyze the data and make some inferences about historical usage between NFH and PSH. Data will be drawn from actual NFH usage as well as data provided by PG&E for PSH. The data items will be chosen to enable computation of predicted electrical and gas usage. The fourth objective will be to develop a forecasting model based on statistical information. The model will be developed to represent an accurate forecast of energy usage. The fifth objective will be to analyze the forecasted energy usage for PSH and if representative, then project any savings that could be generated by creating an incentive system for NFH residents.

E. RESEARCH QUESTIONS

Can the Department of the Navy generate any significant energy and monetary savings by creating an incentive system for NFH residents? If so, what are the predictor variables that should be used and how should they be selected? What would be the cost of implementing monitoring programs and would such programs outweigh the potential savings generated?

F. SCOPE

This study will use energy consumption data of the Naval Postgraduate School's NFH and surrounding community to develop a forecasting model. This thesis will also examine the necessary steps to implement the model in other Navy housing areas.

The main focus of this research will be to develop a forecasting model based on statistical analysis of the historical energy usage data in both NFH and PSH for the past ten years.

It will specifically investigate those variables that will be required in the model to provide a realistic forecast. The thesis does not analyze the energy usage rates or cost for any area other than NPS La Mesa Housing area. Additionally, it is beyond the scope of this thesis to determine exact energy consumption of individual housing units. The intent of the thesis is to illustrate the inefficiencies of NFH residents using gas and electricity.

A summarization of the findings includes recommendations for potential solutions that could be implemented.

G. ASSUMPTIONS

Since it is not practical, given the scope and time limit of this thesis, to measure the efficiency of each housing unit in the sample area, it is assumed that on aggregate, units are alike. Comparison of energy usage data is based on the premise that the aggregate home in the PSH market is of like construction and quality to NFH. It is also assumed that the aggregate household size in PSH is similar to NFH. The thesis only addresses average energy consumption rates. It is not feasible to generate accurate individual usage rates for NFH because individual units are not metered. Additionally, determination of exact individual energy consumption patterns in PSH would not be practical given the time limitations of this thesis.

H. RESEARCH SOURCES

Research for this thesis was conducted using primarily archival research at the Naval Postgraduate School and investigative research at the La Mesa housing complex.

Actual gas and electrical usage for LMV was provided by NPS Public Works Center in the form of Defense Energy Information System (DEIS) reports. These reports are submitted on a monthly basis to Naval Facilities Engineering Command, Port Hueneme, CA for archiving. The DEIS reports provide specific gas and electricity usage each month for La Mesa Housing area.[8] PG&E provided PSH data with a breakdown of gas and electricity usage by city, number of customers, consumption per month, and type of customer.[9] Other data used for the cost-benefits analysis was obtained through personal interviews with PWC engineers and PWC housing staff.

I. ORGANIZATION OF THE STUDY

The thesis is divided into five chapters including the introduction. Chapter II provides the energy consumption review of NPH and PSH based on archival research. Chapter III provides the model selection and predictor variable(s) used to compare and develop a forecast of future gas and electricity consumption to generate an incentive system. Chapter IV presents the findings and analysis from this study. Chapter V provides a brief summary, conclusions and lessons learned from this thesis.

---

[8]NPS reports gas in MBTUs and electricity in mWhrs.

[9]Type of customer refers to single family residents and multiple family dwellings with individual meters. Both of these categories fall under PG&E schedules E-1 and G-1.

II. ARCHIVAL DATA REVIEW

A. BACKGROUND

1. La Mesa Village

NPS manages 877 units in the La Mesa Village Housing (LMV) area. Generally, all units are reserved for the use of students and active duty officers assigned to NPS.[10] Historically, occupancy rates at LMV have varied from 75%, to slightly above 90% (Naval Postgraduate School, 1996, p. 1). The key determinants that affect overall occupancy rates are size of the reporting class and number of units out of service for upgrades. Due to the age of LMV housing units, homes are periodically taken out of service for energy-related upgrades and periodic maintenance. LMV units range between 28 and 45 years old. Table 2.1 lists the type of units available at LMV and the date the units were constructed.

Table 2.1. NPS Housing Inventory

Type	Year Built	# Available
Wherry Units	1952	449
Capehart Units	1962	150
Townhouses	1965	160
Townhouses	1969	118
Total		**877**

In 1994, the Navy funded the renovation and overhaul of 102 Wherry family units. The units were subsequently reopened at the end of 1995. The revitalization project included energy efficient upgrades such as extra installation, double-pane windows, and more efficient gas furnaces and heaters.

In addition to the Wherry upgrades, all other units at LMV have had appliance and gas system upgrades to be more energy-efficient. This thesis

[10]NPS also manages the Presidio of Monterey Annex housing complex. This area is reserved for eligible enlisted members, Defense Language Institute students, and NPS students who could not be assigned in La Mesa.

assumes that for forecasting purposes, on aggregate, LMV units are constructed and equipped similar to the PSH units in the local market.

2. Requirements of Occupancy at LMV

Upon accepting assignment in NFH, a member agrees to forfeit all housing allowances. In return, the member is assigned housing at no cost. The Navy pays all utilities and related maintenance during occupancy. These "no cost" benefits are funded under the Family Housing, Navy and Marine Corps (FH, N&MC) appropriation.

The FH, N&MC appropriation is composed of two categories, Construction and Operations & Maintenance (O&MN). The O&MN component of the appropriation provides funding for the cost of housing management, appliances, services, leasing, repairs and utilities (Shassberger, 1994, p. 17).

The amount of utilities consumed will generally differ from each household depending on the size of the unit and number of occupants per unit. Housing at LMV is assigned based on a person's rank and number of dependents. Field Grade Level officers[11] and members with large families receive quarters with more bedrooms and overall square feet (sq. ft.). Approximately 14% of families in LMV have three or more dependent children; the remaining families have two or less dependent children. The exact demographic make up of LMV is beyond the scope of this thesis, the intent of this section is to illustrate that energy consumption varies depending on size of the unit and number of occupants. It assumes that the average family in LMV is representative of the average PSH family.

3. Gas and Electric Utilities at LMV

PG&E is the sole provider of all gas and electric utilities at LMV. A single master meter for each utility is used to assess the amount of energy consumed by

[11]Field Grade Level Officer generally refers to O-4s and O-5s.

all residents in LMV. As outlined in chapter one, PG&E charges a negotiated price for electricity and the standard master meter rate schedule for gas. Each month, PG&E sends a summary and detailed gas and electric bill to the NPS Comptroller's Office for payment. This bill is then forwarded to the LMV housing office. A budget analyst responsible to the housing manager reviews all charges and authorizes payment. An additional copy of the bill is provided to the energy conservation officer, who submits the summary and detailed bill information into the DEIS-II system. In accordance with Naval Facilities Engineering Command (NAVFAC) instructions, "Commanders and Commanding Officers in charge of real property are responsible for ensuring that all energy-related information is submitted under the DEIS-II system in an accurate, complete and timely fashion" (Naval Facilities Engineering Command, 1988, p.3). Under this reporting system, NPS reports all monthly electricity and gas consumption for LMV. Appendix A provides a sample report.

Based on historical records, PG&E has, on occasion, failed to provide detailed or summary bills on time. Subsequently, DEIS-II energy reports during these time periods do not provide exact energy usage for each month but are instead estimates based on historical usage. A review of these DEIS-II submissions shows usage is under reported during the months when there is no bill, and over reported the following month when the bill includes both prior and current monthly charges. Since data are not available to determine exact usage during months that have anomalies, the actual data reported in the DEIS-II system were used.

4. Navy Energy Conservation Programs

As the facilities expert, NAVFAC issues all guidance and direction related to energy matters (Naval Facilities Engineering Command, 1988. p.1). Locally, NPS has assembled an Energy Conservation Committee to review policies and

make specific recommendations concerning energy utilization. This committee is primarily composed of the Commanding Officer, the Public Works Officer, an Energy Conservation Coordinator, and PWC civilian engineers. The goal of the committee is to "optimize energy costs in support of mission needs" (Naval Facilities Engineering Command, 1988, p.1). Supporting this goal, the Energy Conservation Committee conducts an annual Energy Conservation Week. This is the only program throughout the year that targets LMV residents. During this week, pamphlets, posters, and flyers are placed at various stations in the command. Because the information is not distributed to individual units, one can assume that not all residents receive or review the information. Additionally, since individual units are not metered, no feedback is provided to those residents that are performing energy-conservation techniques.

According to the Congressional Budget Office, utility costs drop by 20% when residents become responsible for their own usage (Congressional Budget Office, 1993, p.22). This thesis makes the assumption that LMV residents, taken as a group, are not conscious of energy usage because they do not pay the costs.

B. ENERGY CONSUMPTION REVIEW OF LMV

1. Introduction

This section examines the consumption rates of gas and electricity for LMV residents and allows comparison to PSH residents in the cities of Monterey and Marina, California. Specifically, consumption is compared on a per household basis. Since it is not practical to determine exact or actual usage of individual residents, an average consumption rate was determined using data that are readily available. Additionally, since the data used in this thesis are a chronologically arranged set of observations, it is consistent with time series data. The underlying assumption of a time series is that there exists a pattern that is a function of time

(Liao, 1996, p.1). These data can be broken down into distinct patterns that influence the value of the overall series, these include (Liao, 1996, pp. 1-2):

- Long-term trend: The trend represents the long-term behavior of the data, and can be increasing, decreasing, or unchanged.
- Seasonal Variation: A time series is said to exhibit a seasonal pattern if the value of the variable changes according to a seasonal regularity.
- Cyclical Variation: A variation with no distinct upward or downward long-term trend with time. Additionally, cyclical factors do not repeat at fixed intervals such as seasonal variations. Cyclical factors generally have a longer duration that varies from cycle to cycle.
- Random Deviations: No discernible pattern to the time series. Values may wander about some average value in a random way. Random deviations include the element of error or randomness that is always present in typical time series data.

2. Actual Electricity Consumption for LMV

Figure 2.1 shows the actual electrical energy consumption per unit assigned (in kWh) for LMV from 1987 to 1996. Note that in 1992, 1993 and 1994 there are large deviations from the historical consumption behavior. These deviations are due to the billing problems described previously and random deviations within the data that cannot be explained. Removing these deviations, the long-term trend suggests that electricity consumption has been fairly consistent from one year to the next with peak consumption remaining below 1000 kWh per unit/per month.

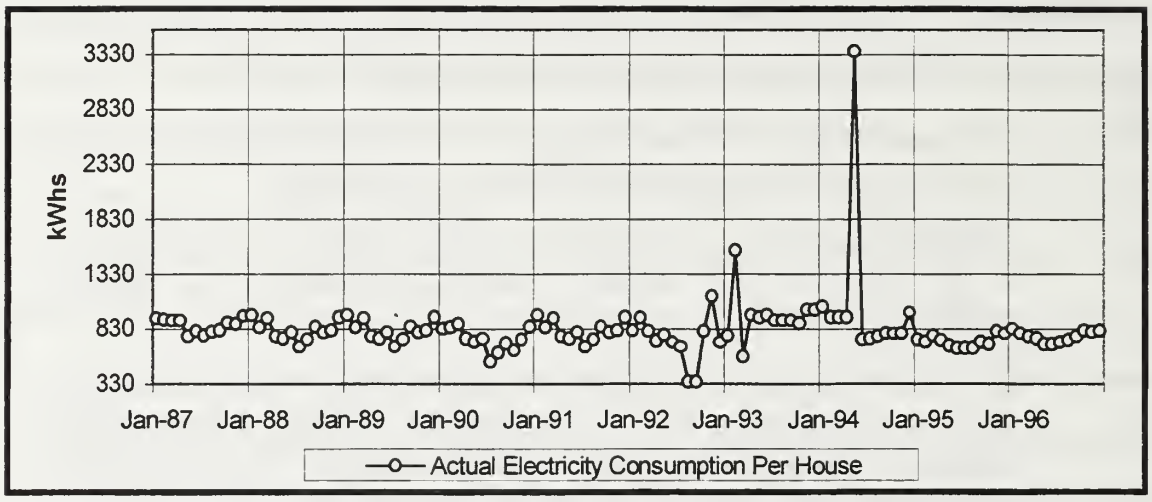

Figure 2.1. La Mesa Housing Electrical Consumption Per Unit

By looking at the time series data in Figure 2.1, a seasonal variation is noted with the highest consumption occurring in the month of January and the lowest consumption occurring in the month of July. Although the values differ from year to year, the differences can be attributed to the random variation or irregular component of the data. The data do not suggest that there are any cyclical variations.

3. Actual Gas Consumption for LMV

A review of gas consumption reveals large deviations in 1993 and 1994. Again, these deviations are a result of billing problems and random error. It should be noted, PWC estimates for monthly gas consumption reported in the 1992 DEIS-II database were fairly consistent with actual consumption. Figure 2.2 illustrates the actual gas consumption behavior per unit/per month as reported in the DEIS II database.

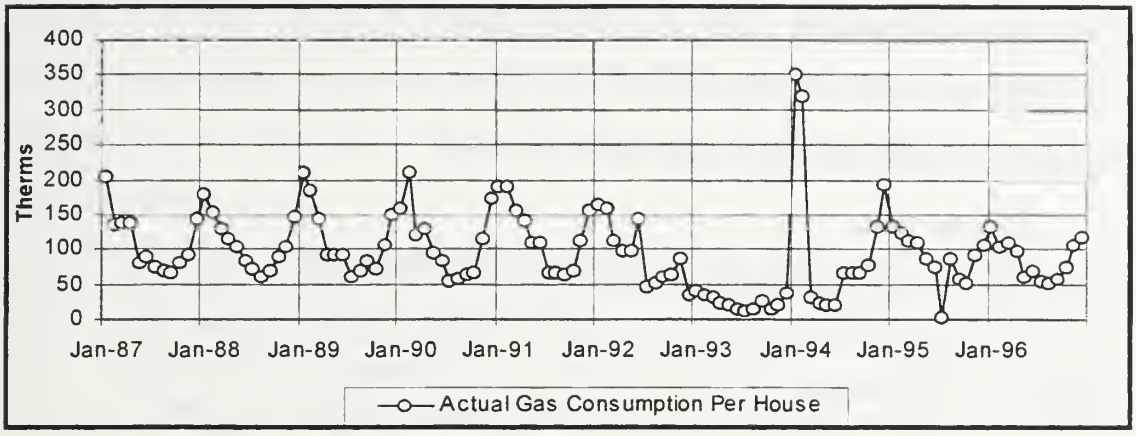

Figure 2.2. La Mesa Housing Gas Consumption Per Unit

The data show seasonal variations that occur every 12 months. There is no indication of cyclical variation in the data. Differences in the consumption patterns from year to year are best explained by the random variations of the data. The long-term trend indicates decreasing consumption over the period studied. The decrease in consumption could be the result of a number of factors. However, since individual units are not monitored for consumption, it is hard to determine the actual cause. The most likely explanation for the decreasing use is that individual residents are reducing overall consumption or savings are being generated from the installation of energy efficient upgrades. A review of the occupancy rates indicates that, from 1994 to 1996, the number of residents at LMV actually increased by 12% (Naval Postgraduate School, 1996, p.1). Because electricity consumption during the same time period did not have a decrease to that observed in Gas consumption, the most reasonable explanation for the declining gas trend would be energy-efficient upgrades. This could be the result of increased efficiency gained from installing more efficient gas furnaces, hot water heaters, and stoves. Although it is assumed that electric appliances were also upgraded, because a majority of LMV occupants are students, the steady trend in

the electricity data, may suggest higher "plug-in-loads" resulting from items such as personnel computer usage (Morse, 1996, Interview).

C. ENERGY CONSUMPTION REVIEW OF PSH

1. Introduction

As stated in the Navy's Energy Management Plan (NEMP),

> Energy management efforts should not adversely affect military readiness, effectiveness, or personnel safety. - **Restrictions shall not be levied on Navy family housing, which would reduce quality of life below that normally available to families in the civilian community** (Naval Facilities Engineering Command, 1988, p.1).

To ensure this thesis conforms to NEMP guidelines on restrictions placed on family housing, a detailed analysis of energy consumption in the PSH was conducted.

Although average energy consumption data are readily available from state agencies, most of the data reflect the consumption patterns of all residents within the state. In order to develop an accurate incentive model to apply to NFH residents, consumption data for the local geographical area must be analyzed. This thesis focuses on two cities within the NPS geographic area, Monterey and Marina.

NPS is located in the city of Monterey, California; therefore, PSH data from this city are relevant to the thesis. Additionally, gas and electric data from the City of Marina, located ten miles north of Monterey, were analyzed to establish accurate PSH consumption patterns. PG&E, detailing the number of customers, the type of commodity and the amount of consumption per commodity provided all energy data (Pacific Gas and Electric Company, 1996, pp. 1-40).

2. Actual Electricity Consumption Patterns for Monterey and Marina

A review of both Monterey and Marina electricity consumption for the past ten years shows a consistent long-term trend. Deviations were observed in both

cities' historical electricity consumption patterns. Although these deviations cannot be precisely explained, there is an indication that a common factor such as temperature was the cause. Figure 2.3 illustrates the electricity consumption for the two cities.

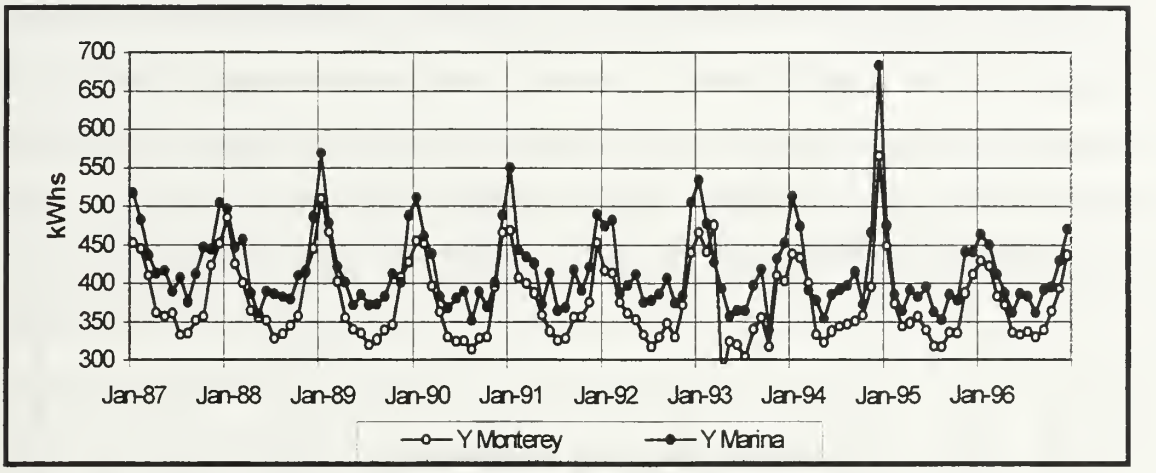

Figure 2.3. Monterey and Marina Electricity Consumption Per Unit

As with LMV, there is a definite seasonal variation within the time series data. The seasonal fluctuations occur each 12-month period, with the highest consumption occurring in the winter months and lowest consumption occurring in the summer months.

The data also suggest that Monterey and Marina consume approximately the same amount of electricity.[12] Although, Monterey's data suggests less overall usage, this can possibly be explained by climatic differences observed between the two cities. An analysis of gas heated versus electric heated homes was also conducted. The results indicate that Monterey has a higher percentage of all-electric homes (19%) versus Marina (14%). These suggest that Monterey residents should use more electricity than Marina residents. Due to the proximity of Monterey Bay, Monterey typically experiences milder winters and summers as compared to Marina, which is more inland.

[12]Differences generally do not exceed 75 kWhs between the two cities.

Seasonal patterns observed in both cities occur at the same periods during the year. No cyclical variation to the time series data was observed. Random deviations again, explain the differences from one year to the next.

3. Actual Gas Consumption Patterns for Monterey and Marina

Figure 2.4 presents the historical gas consumption patterns for Monterey and Marina for the past 10 years. As with the previous energy data, gas consumption varies depending on the season. Use per household is fairly consistent with negligible difference between the two cities.

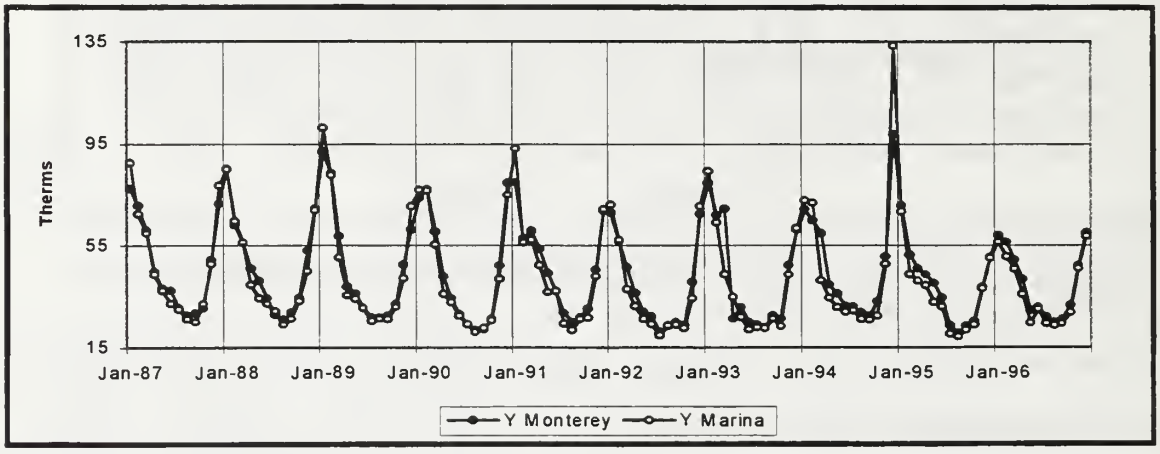

Figure 2.4. Monterey and Marina Gas Consumption Per Unit

Both cities exhibit a decreasing long-term trend over time. The reason for the trend cannot be precisely identified, although it would be rational to assume that homes in both Monterey and Marina have had energy-efficient upgrades over the past ten years. No cyclical variations were observed in the data, which is consistent with all other energy consumption data that were reviewed.

D. LMV VERSUS PSH ENERGY CONSUMPTION

1. Introduction

This section provides an overall comparison of gas and electricity usage per household between LMV and PSH. All data used were provided from DEIS-II energy reports for LMV and PG&E energy summaries for PSH. PG&E provided

the number of customers[13] for the PSH area. The LMV customer base was estimated using occupancy reports from the LMV Housing Office.

Since these rates fluctuate depending on various factors previously described, an average occupancy rate was used for the past two years. These years were selected because the occupancy rate best reflects current energy utilization. The increase in the occupancy rate in late 1995 and 1996 is a result of the 102 Wherry units being placed back into service as well as other units being opened. Figure 2.5 shows the occupancy rates from 1994 to 1996. Future occupancy rates are not expected to exceed 1996 figures. Interviews with LMV Housing Personnel indicate that 284 houses will be removed from service in November 1997. However, to obtain an accurate forecast based on past energy consumption, the average occupancy rate for the past two years was used in the forecasting model.

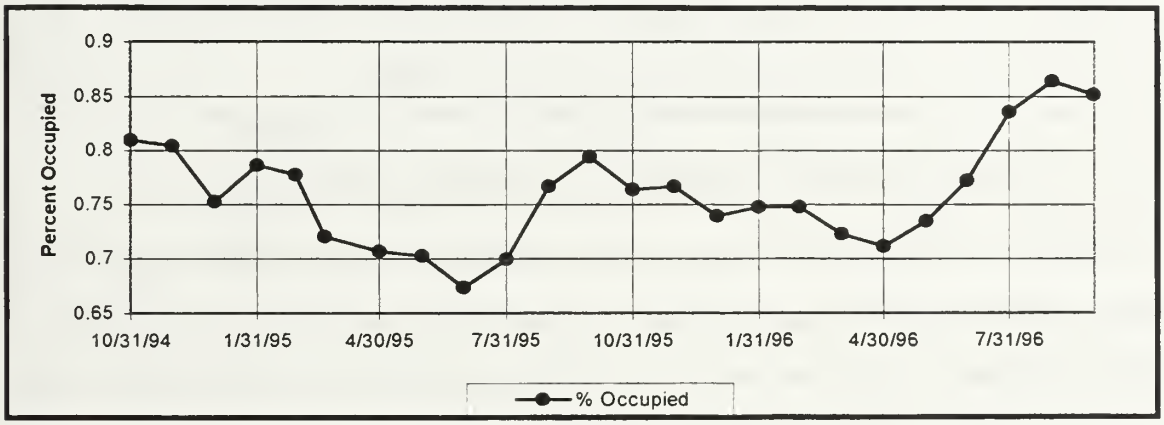

Figure 2.5. LMV Occupancy Rates

2. LMV and PSH Electricity Comparison

As previously illustrated, both LMV and PSH time series data are seasonal in nature and exhibit no cyclical variation. Long-term trends that were identified in the utilities for LMV and PSH are not necessarily correlated to the same variables. Additionally, random deviations in the data cannot be identified with a common variable. Figure 2.6 shows the comparison between LMV and PSH

[13]Customers refer to the number of units that receive gas or electric utilities.

electricity consumption. All data was converted into kWh/per unit/per month to allow ease of comparison. LMV data show more random deviations than both PSH communities. Although it appears that the seasonal variations occur at the same time, the magnitude of usage differs. It is apparent from Figure 2.6 that LMV residents, on average, consume more electricity than their private sector counterparts.

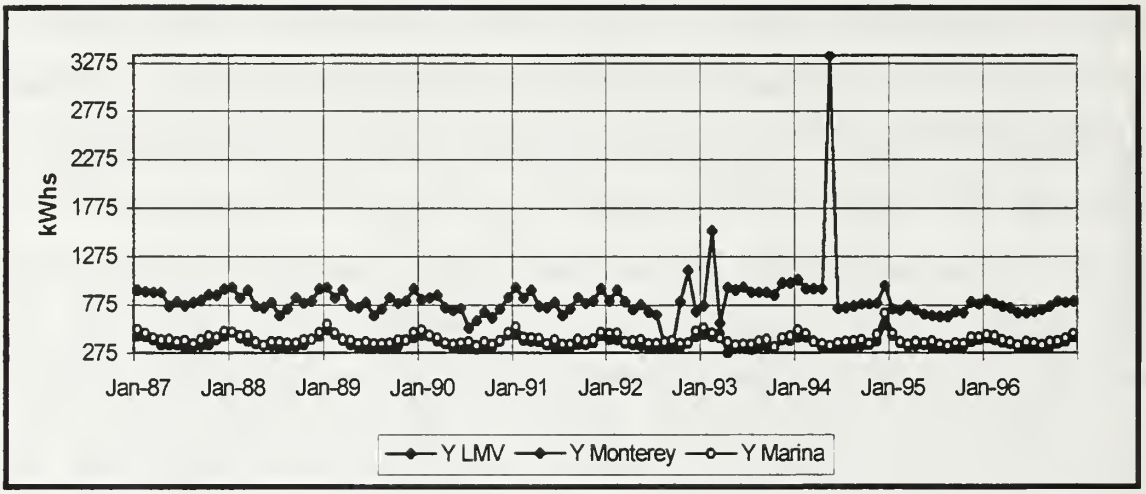

Figure 2.6. LMV Versus PSH Electricity Consumption

Based on ten-year averages, LMV residents use between 98% and 120% more electricity than Marina and Monterey community residents use respectively. Billing problems and random error as previously mentioned caused deviations in LMV data in 1992, 1993 and 1994.

3. LMV and PSH Gas Comparison

Figure 2.7 shows the comparison of gas consumption for LMV and PSH over the past ten years. Again, the data show seasonal variations that occur at approximately the same time periods. As illustrated in sections B and C of this chapter, the long-term trend is decreasing for both LMV and PSH. The rate of decrease for LMV is more rapid than PSH.

A reasonable explanation for this observation is that the Navy has a more aggressive modernization plan, upgrading to energy-efficient appliances, than does the average homeowner. Additionally, major upgrades in LMV are more likely to occur in larger quantities and at the same point in time, due to the budgeting and appropriations process for FH, N&MC.

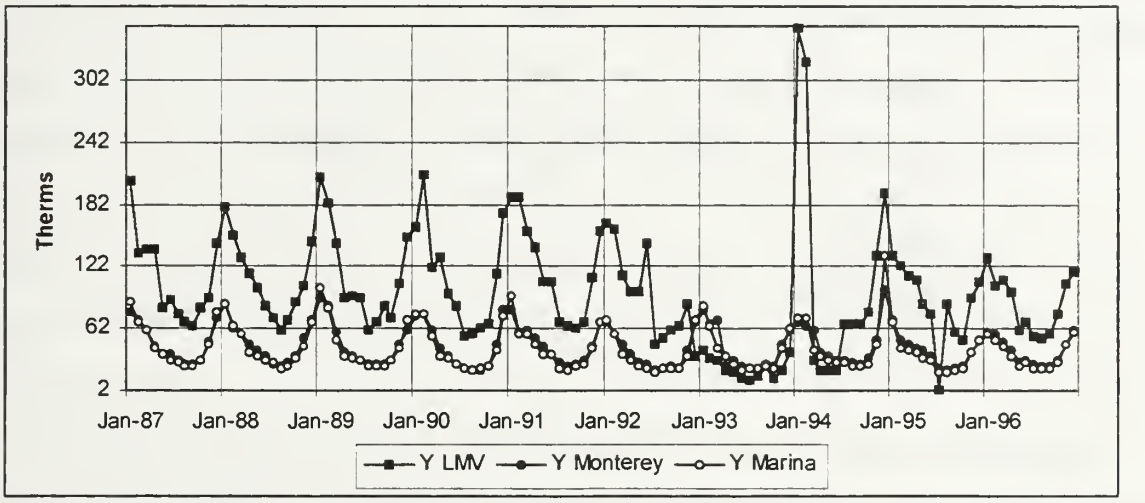

Figure 2.7. LMV Versus PSH Gas Consumption

Like the electricity consumption comparison, LMV gas consumption data show higher usage per household when compared to PSH communities. Specifically, based on a ten-year historical average, LMV residents use approximately 118% more gas than Monterey residents do and 126% more gas than Marina residents use. As with all other LMV data, unusual observations are the result of billing problems and random errors.

E. CONCLUSIONS BASED ON ARCHIVAL DATA REVIEW

1. Summary of Findings

Based on the results of the archival data review, it appears that LMV residents do not practice any energy conservation programs as a whole to save on utility costs. The primary reasons that utility consumption is high likely reside in the facts that residents are not monitored on amounts used, do not pay for utilities

and are not effectively trained in energy conservation programs. In both commodities, the findings indicate an average consumption rate that is twice the consumption of the average PSH resident. If individual months are analyzed, LMV consumption rates per resident are often three times as much as their civilian counterparts. Table 2.2 lists the specific consumption rates for both PSH communities and LMV residents for January 1996.

Table 2.2. Consumption Rate Comparison

City	LMV	Monterey	Marina
Gas (therms)	131	59.1	56.3
Electricity (kWh)	829	428	463

The data from this Chapter clearly indicate a need for some type of incentive program to foster a reduction in energy consumption for NFH residents. Although the data are specific to NPS family housing, it can be assumed that the same inefficiencies are being demonstrated in other NFH areas.

This thesis explores the implementation of an incentive system in NFH to reduce overall energy consumption and ultimately, costs. Chapter III addresses the necessary steps in selecting a model and the predictor variables to allow a forecast to be created based on historical energy consumption. This forecast will then be used to conduct a cost-benefit analysis of the best alternative to creating an incentive for NFH residents.

III. MODEL SELECTION

A. INTRODUCTION

1. Background

Chapter II illustrated the significant differences between LMV and PSH gas and electricity consumption rates. Given the Navy's goal of reducing overall energy consumption by 2005, as hypothesized in Chapter I, creating an incentive program for NFH residents would be beneficial towards reaching this goal. Although there are several initiatives that may be created to meet this goal, the primary focus of this thesis is to determine the effects of privatizing utilities in NFH. Residents would then become responsible for paying the utility provider for all consumption. A Utility Housing Allowance (UHA), based on PSH consumption, would be provided to NFH residents to offset the expected costs of utilities. By creating and providing a UHA, the resident would then become responsible for energy management. In addition to shifting the responsibility from the housing manager to the resident, this method would alleviate the need to budget for energy usage and track NFH energy consumption in the DEIS system.[14]

This chapter shows how the model and variables are selected and used in forecasting gas and electricity usage. Although the data will differ, the following model can be used to implement similar programs in other NFH areas.

2. Model Selection

A critical aspect of creating an incentive program for NFH residents is to accurately forecast future gas and electricity consumption. Generally, forecasting can be classified as either quantitative or qualitative. Quantitative forecasting methods are based on an analysis of historical data. Qualitative methods generally use the judgment of experts to make forecasts in situations where no historical data

[14]Although there may be a need to provide inputs based on local energy rates and estimated population size, the current budgeting system would not be required.

are available (Anderson, Sweeney, and Williams, 1994, pp. 686-687). Figure 3.1 illustrates an overview of forecasting methods (Anderson, Sweeney, and Williams, 1994, p.687). Since the historical data are available, Figure 3.1 only illustrates the quantitative techniques available.

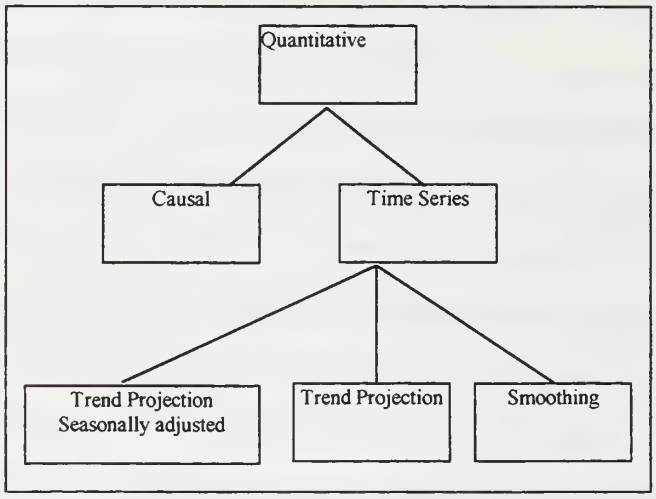

Figure 3.1. Quantitative Forecasting Methods

The first step in determining the appropriate quantitative forecasting model is to determine if time series data are available. Since Chapter II established that data for LMV and PSH energy consumption were time series, then a causal model is not appropriate.

Causal models use regression analysis to show how variables are related. In absence of time series data, this method would be used to develop accurate forecasts. Since time series data is available, the next step is to determine which time series model to use for forecasting.

As discussed in Chapter II, the usual components of a time series can be separated into four components: trend, cyclical, seasonal, and random or irregular errors. These components combine to provide specific values for the time series. By analyzing the time series plot, the choice of model selection can be determined. A discussion of the various methods follows.

a. ***Forecasting Using Smoothing***

If time series data are fairly stable and do not exhibit significant trends, cyclical or seasonal effects, then the objective of the forecasting method is to "smooth out" the irregular component of the time series through an averaging process (Anderson, Sweeney, and Williams, 1994, p. 690). This method can be accomplished by using a moving average, a weighted moving average or exponential smoothing. Since the data in Chapter II indicates a trend and significant seasonal effects, these methods are not discussed.

b. ***Forecasting Using Trend Projection***

If the time series data show some up and down movement that appears linear over time, the data are said to have an upward or downward linear long-term trend. Excluding any significant indication of seasonal or cyclical effects, simple linear trend projection can be used to develop a forecast, based on the historical data. Because not all trends are linear over time, more advanced techniques must be used to forecast curvilinear or nonlinear time series data.

Again, because of the nature of the data being analyzed in this thesis, this method is not applicable. It is assumed that even in the most stable climates, there will be some seasonal variations in gas and electric consumption.

c. ***Forecasting with Trend and Seasonal Components***

If a time series exhibits more than one component previously mentioned, then the components are superimposed on each other. To determine how the individual components affect a time series, the decomposition method must be used. Data used in this thesis show the presence of strong seasonal and trend components. Therefore, this method is used for forecasting future consumption patterns.

B. CLASSICAL DECOMPOSITION METHOD OF FORECASTING

1. Model

Economists have used the classical decomposition method since the beginning of this century to forecast time series data (Liao, 1996 p.1). Equation (1) shows the *multiplicative time series model*, the most common decomposition model:

$$Y = T \times S \times C \times R \quad (1)$$

From this equation, the trend (T), seasonal variation (S), cyclical variation (C) and random error (R) effects can be isolated to determine the predicted forecast value (Y). It should be noted that cyclical effects are recurrent and do not reflect periodic regularity, therefore, are not susceptible to analysis by the decomposition method unless there is a long history of data (Liao, 1996, p. 3).

Decomposition is best suited for analysis of long-term trends and seasonal fluctuations. The random variation (R) accounts for any random effects in the time series that cannot be explained by the trend and seasonal component process (Anderson, Sweeney, and Williams, 1994, p. 701). Given the data available for this study, the decomposition method is the most appropriate tool for analysis.

2. Steps to Create a Forecast Using the Decomposition Method

The following discussion provides the steps and procedure used to create forecasted consumption values for LMV and PSH. Microsoft Excel was used to construct the forecast, however, any similar spreadsheet will allow easy computation of data. Additionally, for the purposes of this thesis, the decomposition example used will be data from LMV gas consumption. LMV electricity consumption and PSH energy consumption are decomposed in a similar fashion.

*a. **Step One***

Determine the moving average to isolate the trend and cyclical influences. The number of terms used for the moving average should equal the length of season. This process will smooth out the data by removing the unusually high and low observations when the values are averaged. In addition, the process will remove periodic variations associated with cyclical periodicity. Therefore, in Equation (2), the moving averages (M) represents: (Liao, 1996, p. 4)

$$M = T \times C \tag{2}$$

Dividing Equation (1) by Equation (2):

$$Y/M = S \times R \tag{3}$$

Equation (3) is the ratio of the actual observed values-to-moving averages, therefore isolating the seasonal and random components of the time series. The most accurate way of obtaining a moving average is to use the *centered moving average* method.

This method centers the moving average to the middle of the averaged data points. Since the data in this thesis displays a strong 12-month seasonal pattern, it is necessary to compute a *double moving average*. This method alleviates the problem associated with centering moving averages with even numbers of terms. The following formula illustrates the procedure: (Liao, 1996, p.5)

$$\begin{gathered} M_{6.5} = (Y_1 + Y_2 + \ldots + Y_{11} + Y_{12})/12 \\ M_{7.5} = (Y_2 + Y_3 + \ldots + Y_{12} + Y_{13})/12 \\ M_7 = (Y_{6.5} + Y_{7.5})/2, \text{ or} \\ M_i = (Y_{i-6} + 2(Y_{i-5} + Y_i + Y_{i+5}) + Y_{i+6})/24 \end{gathered} \tag{4}$$

This procedure calculates the moving average of two twelve-point averages ($M_{6.5}$ and $M_{7.5}$) and sums them together. The average (M_7) is then computed from the two averages ($M_{6.5}$ and $M_{7.5}$) and placed at i=(2+12)/2=7.[15]

[15] i refers to the period in which you are calculating the moving average.

In other words, the moving average for a series with a 12-period seasonal cycle, is actually a 13-period weighted moving average and is placed at period seven (Liao, 1996, pp. 6-7). Table 3.1 provides an abbreviated illustration on how the centered moving average for LMV gas consumption is computed. Note when using a spreadsheet to compute the moving average, Equation (4) can easily be converted as illustrated in the following formula:

Cell D8 = (period 1 value + period 13 value + 2(period 2 + period 3 +..+ period 12))/24.

Table 3.1. Computation of Centered Moving Averages

Period	Value Therms	12-Period Averages	Sum of Adjacent Averages	Centered Moving Averages
1	204.82	-	-	-
2	134.67	-	-	-
3	138.94	-	-	-
4	138.94	-	-	-
5	81.618	-	-	-
6	88.875	-	-	-
		$M_{6.5}$ = 109.559		
7	75.959		216.949	108.474
		$M_{7.5}$ = 107.389		
8	68.976		216.263	108.132
		$M_{8.5}$ = 108.874		
9	...		...	...
		$M_{9.5}$ = ...		
Etc....				

The computations illustrated in Table 3.1 are conducted for the remaining monthly data. Appendices B through G provide the detailed computations for LMV and PSH gas and electricity data.

b. ***Step Two***

Separate the seasonal variations from the long-term trend and cyclical variations and then isolate the random errors. This is accomplished by dividing the centered moving averages into the raw data of the series, Equation (3). The resulting value isolates the effects of seasonal variations and random errors. Because randomness still exists in the ratios, some form of averaging (e.g., mean,

median, or modal value for the same months) is required. The method used in classical decomposition is an approach called the *modified mean method.* (Liao, 1996, pp. 7-9)

c. ***Step Three***

The modified mean method, also called the *medial average method*, computes the mean value for each month after the largest and smallest values have been excluded (Liao, 1996, p.10). This eliminates the year-to-year fluctuations that are attributed primarily to the random errors. The resulting values represent a reasonable estimate of seasonal influences or *seasonal indexes.* Table 3.2 illustrates the procedure for computing the seasonal index.

Table 3.2. Computation of Seasonal Indexes

Month	87	88	89	90	91	92	93	94	95	96	Medial Avg.	Adj. Avg.
Jan		1.66582	**1.86100**	1.42971	1.59525	1.51799	**1.00711**	**4.60160**	**1.31621**	1.58218	1.55819	1.59672
Feb		1.42743	1.63641	1.90542	1.58674	1.48931	0.89002	3.94151	1.24283	1.23422	1.47654	1.51305
Mar		1.22203	1.27759	1.11015	1.29960	1.07038	0.89690	0.36612	1.13381	1.33826	1.16279	1.19155
Apr		1.07163	0.81021	1.20216	1.16233	0.91877	0.72277	0.25158	1.12207	1.18281	1.01700	1.04215
May		0.94877	0.82837	0.88619	0.89808	0.93009	0.73451	0.21303	0.90029	0.71242	0.84949	0.87050
Jun		0.77531	0.82131	0.76759	0.90639	1.46309	0.56376	0.19105	0.84229	0.79570	0.80044	0.82023
Jul	0.70024	0.65681	0.54122	0.48669	0.57368	0.53556	0.33694	0.63627	0.02626		0.55469	0.56840
Aug	0.63789	0.53941	0.62349	0.49888	0.56603	0.67847	0.24673	0.76192	0.99627		0.60906	0.62412
Sep	0.60143	0.60736	0.75741	0.55465	0.56295	0.87617	0.33941	0.79818	0.69736		0.64530	0.66126
Oct	0.75902	0.77336	0.64926	0.57316	0.63569	1.01855	0.18139	0.86059	0.60438		0.68434	0.70126
Nov	0.85570	0.92647	0.94053	0.99028	1.04873	1.52714	0.28046	1.38261	1.11995		1.00519	1.03005
Dec	1.33498	1.29507	1.33264	1.48125	1.44908	0.73054	0.52430	1.90436	1.32488		1.34733	1.38065
											11.7104	12

By rearranging the ratios of actual-to-moving averages by month for all years as shown in Table 3.2, a medial average can be computed. This is done by computing the mean value for each month after the largest and smallest values have been excluded. The number of extreme values to be excluded will depend on the number of observations available. (Liao, 1996, pp. 9-10)

Since this thesis analyzed data for a 10-year period, the two highest and two lowest values were removed. The remaining five observations for each month were used to compute the mean. For example, by looking at the

actual-to-moving average values for January in Table 3.2, we see that the extreme values occur in 1989, 1993, 1994, and 1995. Removing these ratios, we then summed the remaining ratios, 1.665 +1.429 + 1.595 + 1.518 + 1.582 = 7.789. This is then divided by 5 to obtain the medial value of 1.55819. The remaining months are similarly computed. The sum of the medial averages is 11.7014. Note in Table 3.2, that there are only nine years of full data. This is a result of the moving average computations previously discussed.

To achieve a more precise seasonal index, an adjustment is made by multiplying each medial average by 1.02266 = (12/11.7341). This step adjusts the indices as close to one as possible. If the seasonal pattern remains the same in the future, the adjusted average is used as the seasonal index for the period in question in each cycle, past, current, or future. Using this assumption, seasonal indexes can be used to forecast the outcome of a particular month. If a changing seasonal pattern is observed, then a trend-line must be established. This can be accomplished either by visual curve fitting or by the least square method. In this case, the seasonal index will vary from year to year given a particular month. Forecasting under this condition will be more difficult and requires additional quantitative techniques. (Liao, 1996, p. 10)

For the purposes of this thesis, gas and electricity consumption is assumed to remain constant from year to year. Although it is recognized that there may be periodic increases or decreases in consumption, over the long term, usage will remain consistent based on the users past behavior.

d. ***Step Four***

Once seasonal indexes are computed, we can remove the seasonal effects from the time series. Recalling Equation (1), by dividing the observed value (Y) with the seasonal index (S), the resulting ratio, Y/S is referred to as the *deseasonalized or seasonally adjusted* data (Liao, 1996, p. 11). These values can

now be used to determine if a trend exists. Assuming a linear trend exits in the data, then the estimated consumption of utilities expressed as a function of time can be written as follows, Equation (5):

$$T_t = b_0 + b_1 t \quad (5)$$

In this equation, trend of consumption in period t (T_t) equals the intercept of the trend line (b_0) + the slope of the trend line (b_1) x period t. Simply stated, by conducting regression analysis on the ratio Y/S versus time, the resultant value is the least squared straight line derived from the seasonally adjusted data. Figure 3.2 illustrates the regression output for LMV gas consumption.

Regression Statistics	
Multiple R	0.3294894
R Square	0.1085633
Adjusted R Square	0.1010087
Standard Error	35.470097
Observations	120

Analysis of Variance	*df*	*SS*	*MS*	*F*	*Significance F*
Regression	1	18080.03	18080.03	14.370584	0.0002381
Residual	118	148459.08	1258.1278		
Total	119	166539.11			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	116.46453	6.5166109	17.871949	2.295E-35	103.55989	129.36918	103.55989	129.36918
X Variable 1	-0.3543508	0.0934752	-3.7908553	0.0002381	-0.5394569	-0.1692447	-0.5394569	-0.1692447

Figure 3.2. LMV Regression Output

Note that in the summary output of Figure 3.2, the intercept is 116.465 and the X variable is –0.3544. These figures represent the intercept of the trend line and slope of the trend line respectively. Therefore, T_t = 116.465-0.3544t. Since it does not matter what month is chosen as the base period (t), the base period used in this thesis is December 1986. Therefore, December 1986 equals base period 0, January 1987 equals 1, February 1987 equals 2 and so on. Now using only the trend component, we can now forecast future year gas and

electric consumption. For example, substituting t =109 into Equation (5) yields a projection for Janua 1996. Using LMV gas consumption data:

$$T_{109} = 116.465\text{-}0.3544(109) = 77.8354 \quad (6)$$

In other words, using Equation (6), the trend projection forecast only, we would expect a LMV resident to consume 77.8354 therms in January 1996. However, this projection does not account for the seasonal effects. To gain an accurate forecast, we must adjust the data to reflect seasonal indices.

e. ***Step Five***

To obtain an accurate forecast, we simply include the seasonal effects into our trend forecast. This is accomplished by multiplying the seasonal effects (S) with the trend (T). By multiplying Equation (6) by the seasonal index derived in Table 3.2, the projected gas consumption level would be:

$$Y_{\text{Jan 1996}} = 1.59673 \times 77.8354 = 124.282 \text{ therms}$$

To illustrate the predicting ability of the forecasting model, Table 3.3 shows the actual gas consumption per house versus the forecasted gas consumption for LMV in 1996.

Table 3.3. LMV Actual vs. Forecasted Gas Consumption in 1996

Month	Actual	Forecasted	Error	Percent Error	Absolute Value
Jan-96	131.04529	124.28971	6.755579	0.05435	0.05435
Feb-96	103.25103	117.24088	-13.989848	-0.11933	0.11933
Mar-96	110.03605	91.90621	18.129845	0.19726	0.19726
Apr-96	98.382852	80.013914	18.368938	0.22957	0.22957
May-96	60.411057	66.526156	-6.1150989	-0.09192	0.09192
Jun-96	68.260995	62.394253	5.8667425	0.09403	0.09403
Jul-96	54.462751	43.036475	11.426276	0.26550	0.26550
Aug-96	52.834954	47.033789	5.801165	0.12334	0.12334
Sep-96	56.74471	49.598415	7.1462946	0.14408	0.14408
Oct-96	75.74582	52.350538	23.395283	0.44690	0.44690
Nov-96	106.01981	76.529648	29.49016	0.38534	0.38534
Dec-96	117.23183	102.0888	15.143028	0.14833	0.14833
Monthly	**Average**	**Differences:**	**10.118197**	**MAPE:**	**0.1916633**

The data in Table 3.3 suggest that on average, the forecasting model will over predict the amount of therms consumed by a resident by 10.118 therms per month. Assuming a 30-day month, this difference is approximately .34 therms per day.[16] By calculating a Mean, Absolute, Percent Error (MAPE) closeness-of-fit test, we see from Table 3.3, that the MAPE is .1917, or 19%. This tells us that in the LMV Gas Forecasting Model is accurate within 19% for 1996. Although this may appear significant, the purpose for forecasting LMV gas and electricity data, instead of using a ten-year average, is to allow consistent cost comparisons between forecasted PSH data and LMV data in Chapter IV. The reasons for the large errors in LMV data are a result of DEIS-II submission inaccuracies and random error. Because accurate data for PSH were provided by PG&E, the MAPE, as expected, was much lower (The average Electricity MAPE was 3.5% and the average Gas MAPE was 9.5%),[17] therefore validating the methodology used. Chapter IV provides the analysis of PSH forecasts.

3. Cyclical Effects on Time Series Data

Although not specifically illustrated in part B, section 2 of this chapter, the cyclical effects on time series data can also be analyzed. This is accomplished by dividing the seasonally adjusted data (Y/S) by the trend (T). The results will identify the cyclical component expressed as a percentage of trend.

Cyclical effects are analogous to the seasonal component, but over a longer period of time. Due the length of time involved, it is often difficult to obtain enough relevant data to estimate the cyclical component using the decomposition method. Another difficulty is that the length of cycles usually varies (Anderson, Sweeney, and Williams, 1994, p. 709). Therefore, using decomposition for analysis of cyclical effects is rarely attempted.

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[16]A daily comparison is necessary since gas charges are computed on a daily baseline, as mentioned in Chapter I.

[17]Mean, Absolute, Percentage Error results are the average values between Monterey and Marina.

Given the limited observations in electricity and gas consumption data series, a regression model, with potential factors causing business cycles as independent variables, may be used for such an analysis (Liao, 1996, p.12).

C. CONCLUSIONS

This chapter details the most appropriate model, variables and steps in forecasting future gas and electricity consumption in LMV. Assuming historical usage remains constant, then there is a need to create an incentive program to foster savings. Dwindling budget dollars in the Department of the Navy will necessitate the need to consider innovative ideas in reducing overall operating costs. The UHA concept will more closely tie the NFH residents' utility consumption to the PSH community by allocating a specified dollar amount for utilities. If the NFH resident chooses to consume more, then the difference should be paid "out of pocket." Conversely, the resident would be rewarded by being able to retain the difference between the allocated dollar amount and actual payment if consumption is lower.

By conducting an analysis of PSH gas and electricity consumption, as outlined in this chapter, a forecast can be generated for the UHA. Using data that is specific to the geographical area in the NFH location facilitates a more precise analysis of the savings that can be generated, without penalizing the NFH resident. Chapter IV provides an in depth analysis of savings that could be generated if a UHA concept were to be instituted in LMV housing area using PSH consumption data.

IV. ANALYSIS BASED ON PUBLIC SECTOR CONSUMPTION

A. ANALYSIS OF PSH FORECASTED VALUES

1. Introduction

Chapter II demonstrated that La Mesa Village residents consumed more electricity and gas than the average PSH resident. Utilizing the model described in Chapter III, this chapter analyzes the forecasted values generated from PSH data and develops a baseline consumption rate to be applied to LMV residents under the UHA concept. All forecasts in this chapter are based on per house consumption. Therefore, the starting (Y) values in the models are the total commodity consumption divided by the total number of units. In the case of LMV, the total number of units was based on a two-year average of total number of units occupied.

Additionally, this chapter assumes that if the UHA concept were implemented in LMV, the rate schedule currently being charged to NPS, would change to the standard residential schedules as outlined in Chapter I. All cost-benefit analysis under the UHA concept, therefore, uses the standard PG&E E-1 residential electricity schedule and G-1 residential gas schedule.

2. An Analysis of Monterey's Forecasted Electricity Consumption

a. Analysis of the Historical Data

As discussed previously in Chapter II, there is a definite seasonal effect in the historical data. The highest electricity consumption normally occurs in the month of January. Appendix D provides the detailed decomposition of Monterey's electricity consumption for the past ten years using the procedures outlined in Chapter III. The resultant information allows us to better understand the various influences that affect the data. Figure 4.1 shows the seasonally adjusted data (Y/S) plotted against the trend (T). Recall, the trend is the least

square equation from conducting a regression of the deseasonalized data versus time.

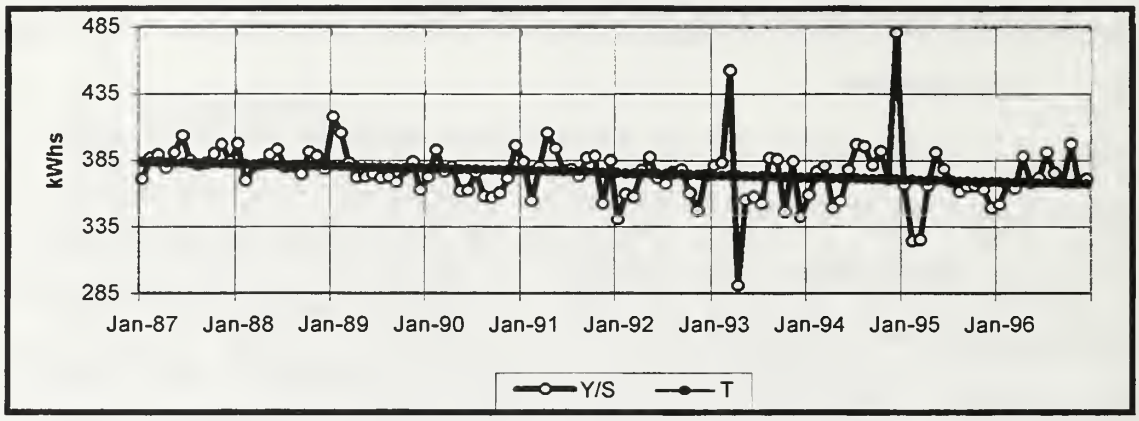


Figure 4.1. Electricity Consumption, Monterey (Y/S vs. T)

We can see that with the seasonal effects removed, there are still some large deviations. These deviations appear to be a result of cyclical effects and random error. Although abnormal temperatures were recorded during this time period, temperature alone cannot explain the large deviations observed (Western Regional Climate Center, 1996, pp. 1-7). Interviews with PG&E officials attribute some of the cause to recording errors, such as billing problems and data entry errors. However, regardless of speculation, pinpointing an exact cause is not feasible. The important fact is that these deviations do not normally occur from year to year and therefore are treated as random errors.

If we look at the smooth trend line (T), then it is apparent that as time passes, the consumption of electricity is decreasing. Explaining the decrease is difficult at best; however, as stated in Chapter II, it is likely the result of new home construction and energy efficient upgrades to older homes. It is assumed that at some point in time the decreasing trend will either stabilize or increase again. To predict that period is beyond the scope of this thesis. However, by using the smooth trend line and adding the seasonal effects back in, we can obtain a forecast of expected future consumption.

b. Analysis of Monterey's Electricity Forecast

By including the seasonal effects into our trend, as illustrated in Figure 4.2, we obtain a fairly accurate forecast of future behavior.

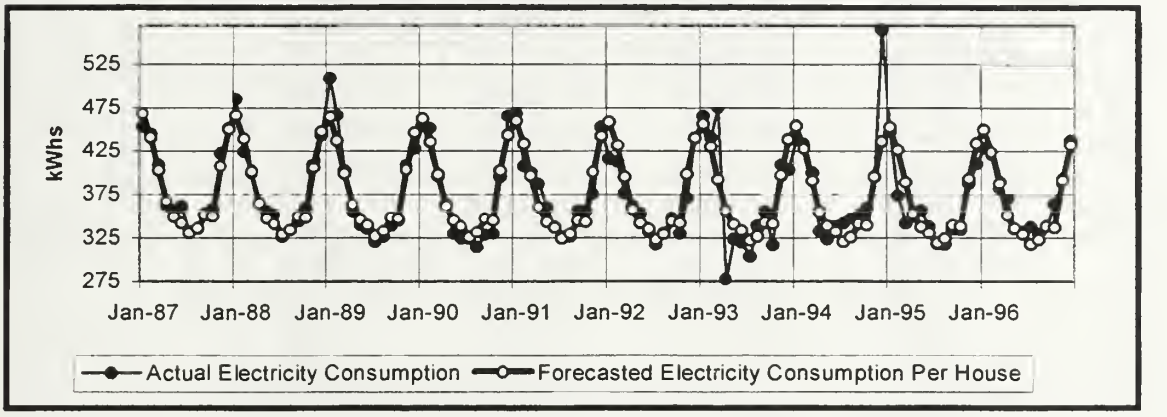


Figure 4.2. Actual vs. Forecasted Electricity Consumption (Monterey)

As we can see, the forecasted values are consistent with historical consumption. Periods in which there were large deviations are smoothed to a value that is representative of historical patterns. Although the forecasted consumption is not exact, from Figure 4.2, it is very close. To obtain a more precise indication of how close the model forecasts historical usage, we can look at the actual and forecasted values for 1996.

Table 4.1 shows the actual and forecasted values for 1996. Notice that the largest difference occurs in October 1996, with a value equal to 27.25 kWhs. What this tells us is that our forecast for October 1996 is 27.25 kWhs less than actual consumption. Although this difference would appear to be significant, if we average all the monthly differences for the entire year, the forecasted values differ by only 4 kWhs.

Table 4.1. Actual vs. Forecasted Electricity Consumption in Monterey (in kWhs)

Month	Actual	Forecasted	**Difference**
Jan-96	428.61177	449.99478	**21.383012**
Feb-96	421.50965	423.75808	**2.2484328**
Mar-96	382.27543	387.2079	**4.932477**
Apr-96	369.82105	351.48545	**-18.335598**
May-96	335.38467	335.67316	**0.2884847**
Jun-96	332.07092	329.03039	**-3.0405382**
Jul-96	337.08301	317.41223	**-19.670783**
Aug-96	329.48721	322.74841	**-6.7387966**
Sep-96	338.73972	337.87322	**-0.8664981**
Oct-96	363.58024	336.32894	**-27.251305**
Nov-96	392.49971	391.3833	**-1.1164106**
Dec-96	436.47068	432.10041	**-4.3702661**
Average	**Monthly**	**Difference:**	**-4.3781491**

By looking at the MAPE closeness-of-fit statistic, as illustrated in Appendix D, we see that the expected error in the forecast for a ten-year period is .0342. This tells us that the forecasted electricity values for Monterey are susceptible to approximately 3% error. Therefore, we can conclude that Monterey residents' should consume 366 kWhs per month in 1997 (± 3%).[18]

3. An Analysis of Monterey's Forecasted Gas Consumption

a. Analysis of the Historical Data

As with the electricity data, the gas data for Monterey, shown in Appendix E, displays strong seasonal effects. Figure 4.3 illustrates the deseasonalized (Y/S) data versus the trend (T).

[18]This figure is an average consumption per month for 1997, based on forecasted values generated from the model.

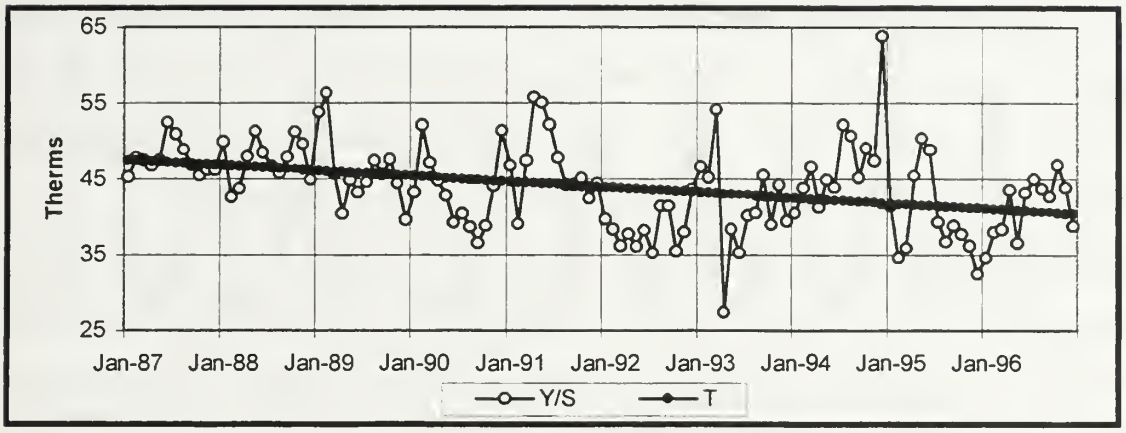


Figure 4.3. Gas Consumption (Monterey) Y/S vs. T

Again, we see large deviations in 1993, 1994 and 1995. These deviations occur in the same periods as the electricity data and can be attributed to random errors. Because the errors occur randomly, they cannot be predicted. It should be pointed out however, by looking at the deseasonalized data, there are more fluctuations in the gas data than there were with the electricity data. This could be the result of temperature changes in Monterey. Because a majority of homes in Monterey are gas heated and few have air conditioning, gas consumption is more susceptible to random errors than electricity consumption. Other areas in which there are NFH may experience similar findings with electricity data during the summer months, due to air conditioning usage.

Looking at the trend in Figure 4.3, we see that there is a decrease. This is consistent with our earlier assumption that over time, newer homes have been constructed and older homes have been upgraded.

b. ***Analysis of Monterey's Gas Forecast***

Figure 4.4 shows the actual gas consumption plotted against the forecasted consumption. Again, it would appear that the forecasted values match the historical data.

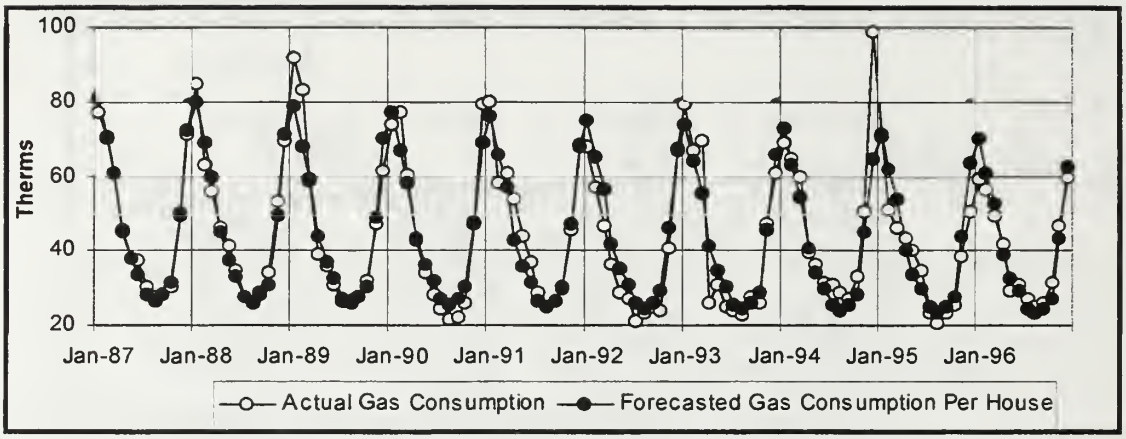


Figure 4.4. Actual vs. Forecasted Gas Consumption (Monterey)

Table 4.2 lists the historical and forecasted values for 1996 providing the individual monthly data, illustrating the specific differences from the model.

Table 4.2. Actual vs. Forecasted Gas Consumption in Monterey (in therms)

Month	Actual	Forecasted	**Difference**
Jan-96	59.102617	70.104489	**11.001872**
Feb-96	56.229263	60.702735	**4.4734719**
Mar-96	49.215626	52.585772	**3.370146**
Apr-96	41.79545	39.282903	**-2.512547**
May-96	29.30549	32.786594	**3.4811046**
Jun-96	30.677409	29.020521	**-1.656888**
Jul-96	26.886684	24.32492	**-2.5617636**
Aug-96	24.727964	23.000411	**-1.7275528**
Sep-96	25.780723	24.497911	**-1.2828126**
Oct-96	31.482249	27.231577	**-4.2506718**
Nov-96	46.934359	43.280359	**-3.6539999**
Dec-96	59.980688	62.503834	**2.5231455**
Average	**Monthly**	**Difference:**	**0.600292**

All gas data have been converted into therms[19] to allow easy cost-benefit analysis later in this chapter. Notice that the largest difference occurs in January 1996. Although this represents a significant amount when compared to the PG&E rate schedule, the average monthly difference over the year is only .60

[19]One Therm equals 100,000 BTUs.

therms per month. To put this into better perspective, the baseline usage in the summer, under the G-1 and GM-1 rate schedule allows .7 therms per day before being charged above baseline rates.

Assuming a 30-day month, the model's forecast is higher than historical data by .02 therms per day. During winter the effect of this forecast is even smaller since the baseline usage rate rises to 1.4 therms per day under the G-1 rate schedule. Looking at the closeness-to-fit statistic, as detailed in Appendix E, we see that our MAPE is equal to 0.092. This tells us that the expected forecasting error is ± 9%. Although this figure is higher than the electricity forecasting error, as discussed previously, we would expect more error in the gas data due to temperature changes. Therefore, using the forecasted figures, we expect the average monthly gas consumption for Monterey residents to be 40.77 (± 9%) therms in 1997.

4. An Analysis of Marina's Forecasted Electricity Consumption

a. Analysis of Historical Data

As with Monterey's electricity and gas data, Marina's electricity consumption shows the same seasonal effects and decreasing trend. Appendix F provides a detailed breakdown of Marina's forecasted electricity consumption; therefore they are not included in this section.

b. Analysis of Marina's Electricity Forecast

Figure 4.5 illustrates the actual and forecasted electricity consumption for Marina for the past ten years. Note that the forecasted values closely follow the actual historical data. This is a good indication that the historical data is predictive of future consumption patterns.

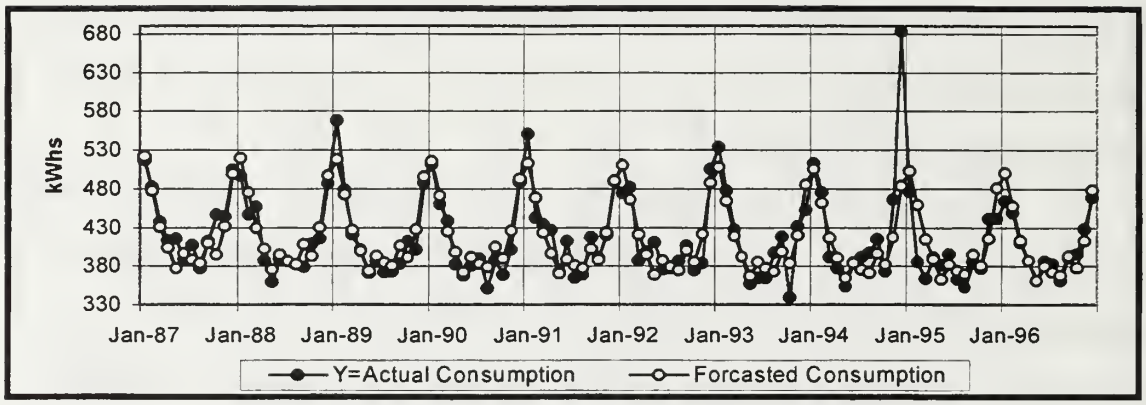


Figure 4.5. Actual vs. Forecasted Electricity Consumption (Marina)

Again, looking at the actual values and forecasted values for 1996, we can better evaluate the accuracy of the model. Table 4.3 provides a detailed breakdown of the 1996 data.

Table 4.3. Actual vs. Forecasted Electricity Consumption in Marina (in kWhs)

Month	Actual	Forecasted	**Difference**
Jan-96	463.77316	500.12141	**36.348**
Feb-96	449.15626	457.04313	**7.887**
Mar-96	410.49641	412.61524	**2.119**
Apr-96	386.68418	386.60045	**-0.084**
May-96	361.27011	361.18058	**-0.090**
Jun-96	385.75991	379.72763	**-6.032**
Jul-96	382.43327	371.59278	**-10.840**
Aug-96	361.12824	367.58015	**6.452**
Sep-96	390.63032	392.64898	**2.019**
Oct-96	395.26144	378.13267	**-17.129**
Nov-96	428.32647	413.17111	**-15.155**
Dec-96	469.35112	478.17592	**8.825**
Average	**Monthly**	**Difference:**	**1.193**

The average difference per month using the forecasting model is 1.193 kWhs. Using the E-1 residential rate schedule, this amounts to a difference of less than $0.1589 per month. By evaluating the MAPE, in Appendix F, the expected forecasting error is ± 4%. This is consistent with the error in Monterey's

electricity data. We can thus say that the model is valid and can be used to predict future electricity consumption for Marina. Therefore, we expect an average monthly consumption of 412.612 (± 4%) kWhs for Marina residents in 1997.

5. Marina's Forecasted Gas Consumption Analysis

a. Analysis of Historical Data

As stated in Chapter II, Marina's gas data also show seasonal influences and therefore were an excellent candidate for the decomposition method. Appendix G provides the detailed decomposition forecast of Marina's gas data. Although the number of customers from 1987 to 1996 has grown approximately 17%, the overall trend has decreased like the previous data. This tells us that some other factor, such as energy efficient upgrades, can be attributed with the decrease.

b. Analysis of Marina's Gas Forecast

Figure 4.6 shows that the forecasted gas consumption for Marina is very close to historical data. Initially, this is a good indication that the model has the predictive feature that we desire.

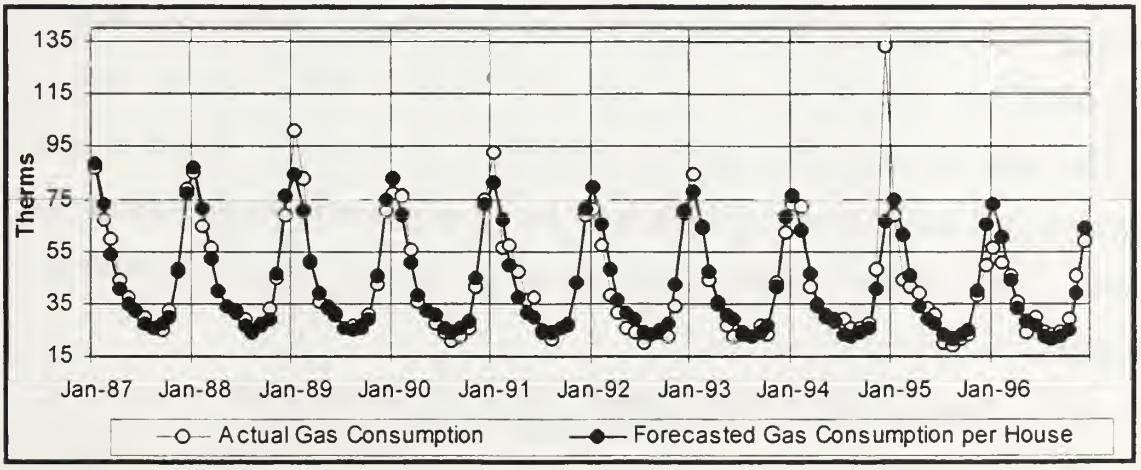


Figure 4.6. Actual vs. Forecasted Gas Consumption (Marina)

To make sure that there are no unexpected deviations between the actual and forecasted values, an analysis of the 1996 data was conducted. Table 4.4 provides the specific details.

Table 4.4. Actual vs. Forecasted Gas Consumption in Marina (in therms)

Month	Actual	Forecasted	Difference
Jan-96	56.325979	72.963086	**16.637107**
Feb-96	50.523696	60.233885	**9.7101888**
Mar-96	45.645225	44.27745	**-1.3677754**
Apr-96	35.940852	33.509818	**-2.4310339**
May-96	24.51792	28.534862	**4.016942**
Jun-96	30.108666	26.767544	**-3.3411213**
Jul-96	24.320888	22.339932	**-1.9809559**
Aug-96	23.482826	21.23106	**-2.2517659**
Sep-96	24.367535	22.703788	**-1.6637469**
Oct-96	28.771188	24.672282	**-4.0989065**
Nov-96	46.009245	38.879597	**-7.1296475**
Dec-96	58.843818	63.660079	**4.8162615**
Average	**Monthly**	**Difference:**	**0.9096288**

Although the average difference per month is greater than Monterey, it is still not significant enough to make the model invalid. Using a daily baseline rate allocation of .7 therms in the summer and 1.9 therms in the winter, this difference would represent a 0.03 therm increase from the daily historical usage.[20] Additionally, the MAPE, shown in Appendix G, is ± 10%. Again, this is consistent with the amount of error in Monterey's gas forecast. Based on this information, we can conclude that Marina's gas model is accurate for forecasting purposes. The average monthly consumption for gas in Marina is, therefore, computed at 38.31 (± 10%) therms.

6. Summary of PSH Forecasts

As demonstrated in the previous sections, all data used to forecast consumption demonstrated similar patterns. This includes seasonal effects and decreasing trends. Although, the random errors (or deviations) differed, the cause

[20]A 30-day month was used for this calculation.

cannot be specifically identified to one event. However, the decomposition method smoothes out these random errors by using the sum of the square regression line as the foundation for the forecast. When seasonal effects are added back into the model, we have demonstrated that the forecasted values in all cases are predictive of future consumption patterns, given some acceptable error.

Using these models, forecasts were developed for future years to establish a baseline consumption rate for the UHA concept. By comparing the baseline rates established for the UHA to the historical consumption rates of LMV residents, the potential savings can be analyzed.

B. ESTABLISHMENT OF BASELINE USAGE RATES

1. Determination of Electricity Baseline for the UHA Concept

By using the forecasting models developed in the previous sections, we can now set a baseline electricity consumption rate for LMV residents. Table 4.5 compares the forecasted values for 1997 between Monterey and Marina.

Table 4.5. 1997 Electricity Forecast for Monterey and Marina (in kWhs)

Month	Monterey	Marina	Difference
Jan-97	447.97657	497.69141	**-49.714835**
Feb-97	421.85683	454.82153	**-32.964702**
Mar-97	385.46999	410.60879	**-25.138796**
Apr-97	349.90729	384.71974	**-34.81245**
May-97	334.16542	359.42281	**-25.257392**
Jun-97	327.55193	377.87885	**-50.32692**
Jul-97	315.98544	369.78288	**-53.797434**
Aug-97	321.2971	365.78907	**-44.491967**
Sep-97	336.35332	390.73497	**-54.381647**
Oct-97	334.81542	376.28866	**-41.473241**
Nov-97	389.62137	411.15542	**-21.534047**
Dec-97	430.15446	475.84215	**-45.687694**
Monthly Average	**366.26293**	**406.22802**	**-39.9651**

From Table 4.5 we see that Marina residents consume more electricity than does Monterey residents. The average monthly difference is approximately 40 kWhs or on a daily basis 1.33 kWhs.

By averaging the two cities forecasted consumption, we can generate a reasonable UHA baseline rate. Therefore, for the purposes of this thesis, the average monthly baseline rate established for the UHA concept is 386.25 kWhs. Error is computed as the average difference between Monterey and Marina forecasted errors. Therefore the expected error is 3.5%.

2. Determination of Gas Baseline for the UHA Concept

Using the same procedure as was used for the electricity baseline, the baseline rate for gas is developed by averaging Monterey and Marina's forecasted 1997 gas consumption. Table 4.6 illustrates the differences.

Table 4.6. 1997 Gas Forecast for Monterey and Marina (in therms)

Month	Monterey	Marina	**Difference**
Jan-97	68.886418	71.253993	**-2.3675758**
Feb-97	59.646491	58.820202	**0.8262882**
Mar-97	51.669436	43.236227	**8.4332088**
Apr-97	38.597381	32.720258	**5.8771235**
May-97	32.213606	27.8612	**4.352406**
Jun-97	28.51261	26.13436	**2.3782505**
Jul-97	23.898569	21.810439	**2.0881299**
Aug-97	22.596685	20.726853	**1.8698319**
Sep-97	24.067269	22.163536	**1.903733**
Oct-97	26.752179	24.084022	**2.6681574**
Nov-97	42.517311	37.950748	**4.5665632**
Dec-97	61.400247	62.13618	**-0.7359327**
Monthly Average	**40.063184**	**37.408168**	**2.6550153**

Notice that the differences in gas consumption are minimal. The average monthly difference is only 2.656 therms between the two cities. Using the average monthly value between the two cities, the baseline rate for gas consumption under the UHA concept is established at 38.74 (± 9.5%) therms per month.

C. COST-BENEFITS ANALYSIS

1. Cost of Implementing the UHA Concept in LMV

In order to implement a monitoring program in LMV, two events must occur. The first is the installation of meter bases, to facilitate the mounting of an electricity meter. The second event that must occur is the installation of gas meters and the associated piping to allow monitoring. Because this thesis is based on the total outsourcing of utilities to PG&E, the Utilities Company incurs some of these costs.

a. Electricity Meter Installation Costs

Based on engineering estimates, the cost to install a single position, 4 terminal, 100-amp meter socket, the standard residential home socket, would be a total of $144.00 per installation (RSMeans, 1997, p.182). This cost includes the material at $27.50, labor at $75.00 and includes overhead and profit. The Navy would be responsible for the cost of this installation. PG&E would provide the meters at no charge, although they would make up for the cost of the meter and personnel to monitor the meters through the standard E-1 residential rate schedule. Total cost of metering LMV would be a one-time charge of $75,576.00. This figure is based on 606 total homes in LMV with the 102 Wherry units already upgraded with electricity sockets.

b. Gas Meter Installation Costs

Generally, gas meter installation requires underground piping from the street to the house. Since all homes in LMV are equipped with gas, this requirement is not necessary. Additionally, since PG&E owns all gas equipment from the street to the house, they would bear the cost of installing meters in individual units (Morse, 1997, Interview). Again, PG&E recovers the cost of meter installation and monitoring in the rate schedule. Total initial cost to the Navy would then be $0.00.

2. Savings Generated from Implementing a UHA

a. Electricity Savings

Using the E-1 rate schedule and the forecasted baseline consumption rates from the previous sections, we would expect the total electricity charge per house to be approximately $565.00 annually. Total cost to the Navy based on 606 occupied homes would be $342,390.00 per year, under the UHA concept. Appendix H provides the detailed cost breakdown for electricity and gas using PSH forecasts and rate schedules.

Comparatively, using the LMV 1997 forecast, which assumes no incentive system as detailed in Appendix B, we would expect the total electricity charge per house to be approximately $689.35 annually. Appendix I provides the specific calculations. Using the same 606 homes, the total cost to the Navy under the existing system would be $417,746.00.[21]

Annual electricity saving generated from switching to a UHA concept is approximately $75,356.00. Therefore, the payback period for installation of metering boxes is essentially one year. In light of the Navy's Year 2005 goal of reducing energy consumption by 30% per square foot, implementation of the UHA concept could generate a reduction in electricity usage by 54.1% per square foot/per month.

b. Gas Savings

As stated in Chapter I, NPS is charged the GM-1 rate schedule for gas utilities provided in LMV. Under this schedule, the charges are the same as the residential G-1 schedule; with the only difference between the two being the baseline quantities. Using the GM-1 and G-1 rate schedules, the summer baseline

[21]It was not feasible to determine the exact breakdown of individual costs under the special rate schedule for electricity without detailed monthly summary bills from PG&E. These bills were not available for analysis. Costs include a user fee, demand fee and energy fee. Instead, an average cost was determined from the DEIS II reports, by totaling annual consumption and dividing this figure by annual charges. Charge per kWh was approximately $0.069.

quantity is .7 therms per day. However, during winter, the baseline quantity for the GM-1 rate schedule is 1.4 therms per day as opposed to the G-1 baseline quantity of 1.9 therms per day. Simply stated, during winter, NPS pays above baseline rates faster than the PSH residents do.

As illustrated in Appendix H, the expected average monthly gas charge for PSH residents is $28.20, for an annual cost of $338.40. Using this baseline consumption rate, the total annual cost to the Navy would be $205,070.40 if the UHA concept were instituted. Conversely, using the LMV gas forecast, Appendix C, under the current system, with no incentive for residents to save the average monthly charge per resident is projected to be $54.73. The total annual cost under the existing system is $656.79 per resident. Based on 606 occupied units, the Navy's bill would be $398,014.74 per year.

Total gas savings from adopting the UHA concept is $192,944.34 annually. Additionally, gas reduction per square foot/per month is estimated to be 45.9%. Savings would be immediate, since there are no up front charges associated with switching to a monitored program.

V. SUMMARY AND CONCLUSIONS

A. SUMMARY

Chapter I outlined the Department of the Navy's energy strategy, with the goal of reducing overall energy consumption by 30 percent per square foot by the year 2005. As was shown in Chapter II, the average consumption of electricity and gas for LMV residents is generally two to three times higher than the PSH residents' consumption. Because the NFH resident does not pay for utilities, there are no real incentives for the NFH resident to reduce overall consumption.

Given a finite amount of resources, PSH residents will generally employ some type of energy reduction program. The energy consumption data for the cities of Monterey and Marina presumably reflect this rational behavior. Therefore, it is logical to use the PSH consumption patterns of electric and gas utilities as a benchmark to evaluate any incentive programs targeted at NFH residents. One recommendation, and the focus of this thesis, was to institute a Utility Housing Allowance based on the local PSH consumption rates. NFH residents would then use the allowance to pay the utility provider directly. Any usage of electricity and gas above the baseline established for the UHA would be paid "out of pocket" by the NFH resident.

B. CONCLUSIONS

This thesis explored the savings that could be generated by instituting a UHA at the Naval Postgraduate School's La Mesa Village housing complex. Using past consumption rates of gas and electricity, and then generating a forecasting model to predict future consumption, a comparison was made between LMV and PSH residents. Chapter IV demonstrated that, by instituting a UHA based on PSH consumption, the Navy could save approximately $268,300.00 annually. Although there is a one-time charge of installing meter boxes in existing

homes, this cost would be recouped within the first year from both electricity and gas savings. In addition to the UHA concept reducing overall costs to the Navy, it is assumed that residents will become more conscious about energy usage, therefore, meeting the Navy's goal of a 30 percent per square foot reduction. Table 5.1 provides an illustration of the total reductions that could be achieved by implementation of a UHA based on 1997 forecasted values per month.

Table 5.1. Energy Savings per SQ. FT.

Electricity Savings per SQ. FT.		Gas Savings per SQ. FT.	
Current	**UHA**	**Existing**	**UHA**
.7040 kWhs	.3226 kWhs	.0605 therms	.0327 therms
Savings	.5419%	**Savings**	.4593 %

Theoretically, the overall savings that could be generated from implementing the UHA concept is 50.0 % per month in 1997.[22] Of course there may be NFH residents that exceed the baseline rates established, but it is also assumed that others will be below it. Therefore, in the first year alone, LMV residents would meet the goals set by the Navy.

Although this study focused on the Naval Postgraduate School's family housing area, it is assumed that similar inefficiencies in utility consumption are being demonstrated in other NFH areas. Therefore, the benefits derived from implementing a UHA concept are potentially significant when applied to all NFH residents.

C. RECOMMENDATIONS

The following actions are recommended:

- Immediately implement a Utility Housing Allowance concept based on the local Public Sector Housing consumption rates. As demonstrated in this thesis, doing so will dramatically reduce the overall energy costs currently being paid.

[22]Figure derived from the average savings between gas and electricity, based on 1997 forecasted values. Additionally, SQ. FT. of LMV homes derived from the average of all home sizes in LMV.

- Implement the forecasting methods developed in Chapter III to assess the differences in NFH energy consumption and PSH consumption.
- Implement a monitoring program for gas and electricity. Although the Navy is responsible for some costs, as outlined in Chapter IV, generally, the Utility Company subsidizes the bulk of the costs.
- Require all residents of NFH to attend energy conservation seminars. As stated in Chapter I, the current energy awareness programs do not target individual residents. Often conducted in a lackadaisical fashion, these programs are generally not implemented to their fullest potential. Joint training with representatives from Naval Engineering Facilities Command, Western Division (WESTDIV), Public Works, Housing, and Residents, can foster new and innovative solutions to reducing overall energy consumption.
- This thesis assumes that if the UHA concept were implemented, PSH rate schedules would be charged to NFH residents. With the implementation of utility deregulation in the State of California, request that WESTDIV examine the feasibility of obtaining a special rate schedule for NFH residents, under the UHA concept.

D. FOLLOW-ON RESEARCH

The study of implementing a Utility Housing Allowance as an incentive for NFH residents to reduce energy consumption has generated a number of related issues that were not addressed in this thesis. These issues may serve as possible topics for further study.

Although this study proposes the UHA concept to reduce consumption of utilities, the thesis did not explore all the possible incentive programs that could be implemented. One possible research topic might be to determine the effectiveness of monitoring programs that are implemented and conducted by the various Navy Commands. Since the utility provider will not pay for these costs, this study should include the cost of installing meters and the personnel to monitor the program. It should also include the most cost effective monitoring systems, such as telemetry type meters versus personnel monitored meters. Additionally, a

procedure to enforce compliance would also have to be analyzed. After determining the specific procedures for implementing this system it could be compared to the proposed program, as outlined in this thesis, to determine the most cost effective alternative.

As stated in Chapter I of this thesis, due to the scope and time limitation, the efficiency of individual homes between PSH and NFH were assumed to be equal. As a means of reducing energy consumption and ultimately costs, a study determining the efficiency of NFH compared to PSH would be extremely beneficial.

A detailed analysis of the energy requirements for different family sizes would also be beneficial. Although this thesis used the aggregate PSH home and compared it to the aggregate NFH home, it did not specifically address the individual energy needs based on family size. If the energy requirements based on family size are significantly different from the findings in this thesis, then the baseline rates established in Chapter IV may have to be adjusted.

Because of time limitations this thesis did not research the laws and regulations that might preclude the implementation of the UHA concept. A study that researches any restrictions with regards to the UHA concept would be beneficial. The research should detail any modifications to existing laws and regulations that would be required to allow the implementation of the UHA concept.

APPENDIX A. DEISS ENERGY REPORT

NAVPGSCOL, MONTEREY, CA

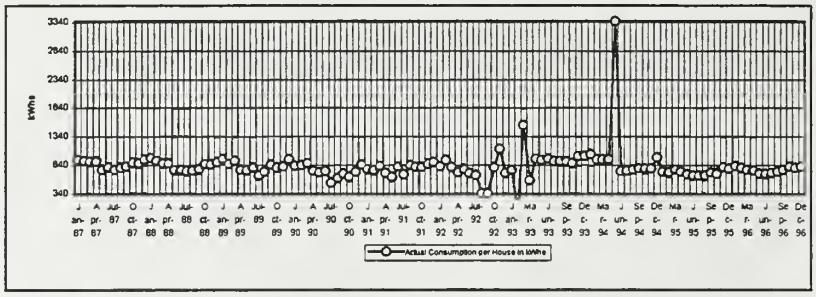
Month	Apr		May		Jun	
	Unit	Cost	Unit	Cost	Unit	Cost
ELECTRIC	MWHRS	$	MWHRS	$	MWHRS	$
Mainstation	1366	90018.29	1359	121212.1	1352	139734
La MESA	629	40473.84	612	40154.04	628	40200
ANNEX	1326	89432.56	1385	92117.46	1376	45965
NATUARL GAS	MBTU		MBTU		MBTU	
Mainstation	8593	28232.95	8912	28704	4219	12083.42
La MESA	1475	8727.79	1266	7644.37	877	5795
ANNEX	0	0	0	0	5112	27508
FUEL OIL	MBTU		MBTU		MBTU	
Mainstation	4	20.72	2	18.92	3	15
La MESA	0	0	0	0	0	0
ANNEX	29	157.18	29	151.12	43	224

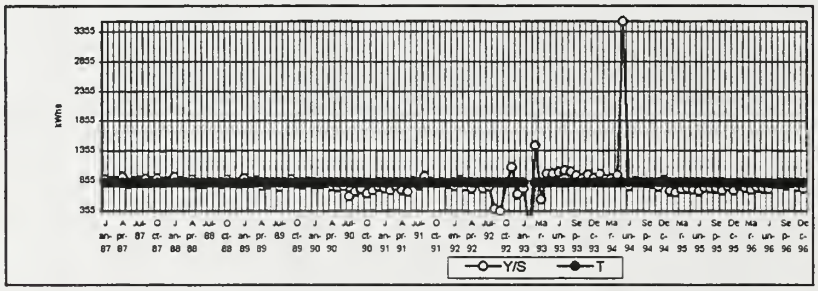
APPENDIX B. LA MESA ELECTRICTY CONSUMPTION PER HOUSE IN kWhs

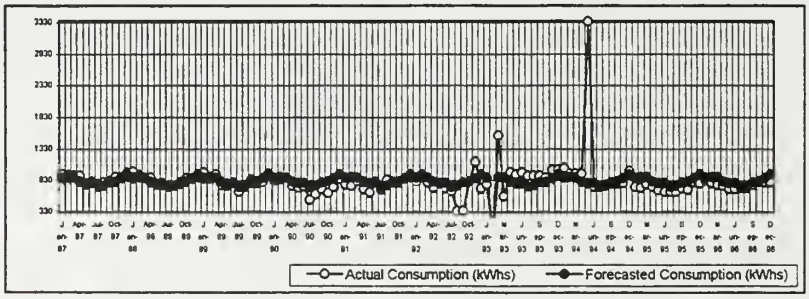
Month	Period	Y (MWh)	MA	YMA	S	Y/S	T	Y=T*S	Error	Percent Error	Absolute Value	Regression Output
Jan-87	1	929.517898			1.05669817	879.643709	824.281671	871.016934	58.5009645	0.067163981	0.067163981	824.2616305
Feb-87	2	915.826145			1.07114737	854.995466	824.301712	882.948611	32.8775345	0.037236068	0.037236068	0.020040571
Mar-87	3	908.219616			1.06602123	851.971417	824.321752	878.744486	29.4751294	0.033542321	0.033542321	
Apr-87	4	908.219616			0.98753952	919.679257	824.341793	814.070102	94.1495141	0.115652834	0.115652834	
May-87	5	763.695556			0.95281123	801.518212	824.361833	785.461216	-21.7656593	-0.027710674	0.027710674	
Jun-87	6	807.813427			0.96046436	841.06549	824.381874	791.789409	16.0240184	0.020237728	0.020237728	
Jul-87	7	766.738168	862.2635	0.88921561	0.88087076	870.43208	824.401914	726.191541	40.5466273	0.055834618	0.055834618	
Aug-87	8	800.206898	864.101745	0.92605634	0.90286722	886.29522	824.421955	744.343555	55.8633426	0.075050482	0.075050482	
Sep-87	9	823.026486	862.83399	0.95386424	0.96909026	849.277426	824.441996	798.958712	24.0677742	0.030123927	0.030123927	
Oct-87	10	885.400027	859.918154	1.02963291	0.98892792	895.313	824.462036	815.33353	70.066497	0.085935994	0.085935994	
Nov-87	11	871.708274	858.33346	1.01558231	1.04315559	835.645497	824.482077	860.06309	11.6451845	0.013539919	0.013539919	
Dec-87	12	946.252263	856.431828	1.10487751	1.12040636	844.56167	824.502117	923.777413	22.4748501	0.024329292	0.024329292	
Jan-88	13	970.593157	853.199053	1.13759287	1.05669817	918.515035	824.522158	871.271056	99.3221015	0.113996788	0.113996788	
Feb-88	14	918.868757	849.522564	1.08162961	1.07114737	857.835983	824.542198	883.206208	35.6625494	0.040378509	0.040378509	
Mar-88	15	874.750886	845.022034	1.03518116	1.06602123	820.575485	824.562239	879.00085	-4.24996428	-0.004834994	0.004834994	
Apr-88	16	871.708274	842.106197	1.03515243	0.98753952	882.707227	824.58228	814.307592	57.4006825	0.070490172	0.070490172	
May-88	17	762.17425	840.521504	0.90678733	0.95281123	799.921562	824.60232	785.690354	-23.5161038	-0.029930498	0.029930498	
Jun-88	18	763.695556	837.605667	0.91176025	0.96046436	795.131593	824.622361	792.020388	-28.3248314	-0.035762755	0.035762755	
Jul-88	19	733.269438	834.943382	0.87822654	0.88087076	832.437029	824.642401	726.403379	6.86605987	0.009452131	0.009452131	
Aug-88	20	745.439886	831.90077	0.89606827	0.90286722	825.636232	824.662442	744.560683	0.87920287	0.001180834	0.001180834	
Sep-88	21	769.78078	831.583832	0.92568031	0.96909026	794.333415	824.682482	799.191765	-29.4109854	-0.036800911	0.036800911	
Oct-88	22	868.665663	829.048322	1.04778653	0.98892792	878.391277	824.702523	815.571355	53.0943081	0.065100752	0.065100752	
Nov-88	23	850.409992	823.787139	1.03231764	1.04315559	815.22833	824.722564	860.313955	-9.90396319	-0.011512034	0.011512034	
Dec-88	24	897.570474	824.547792	1.08856089	1.12040636	801.111552	824.742604	924.046856	-26.4763814	-0.028652639	0.028652639	
Jan-89	25	955.380098	822.89971	1.16099214	1.05669817	904.118248	824.762645	871.525178	83.8549206	0.096216292	0.096216292	
Feb-89	26	861.059133	819.223221	1.05106778	1.07114737	803.866169	824.782685	883.463804	-22.4046713	-0.025360033	0.025360033	
Mar-89	27	924.95398	821.885507	1.12540491	1.06602123	867.669383	824.802726	879.257215	45.696766	0.051972011	0.051972011	
Apr-89	28	760.652944	822.012282	0.92535472	0.98753952	770.250634	824.822766	814.545082	-53.8921376	-0.066162253	0.066162253	
May-89	29	746.961191	817.448364	0.91377171	0.95281123	783.955064	824.842807	785.919493	-38.9583013	-0.049570346	0.049570346	
Jun-89	30	797.164286	817.892079	0.97465706	0.96046436	829.977997	824.862848	792.251367	4.91291907	0.006201212	0.006201212	
Jul-89	31	660.246756	814.595916	0.81052058	0.88087076	749.538736	824.882888	726.615216	-66.3684606	-0.091339211	0.091339211	
Aug-89	32	730.226827	808.764243	0.90289208	0.90286722	808.786513	824.902929	744.77781	-14.5509837	-0.019537349	0.019537349	
Sep-89	33	848.888686	805.848407	1.0534099	0.96909026	875.964517	824.922969	799.424819	49.4638674	0.06187432	0.06187432	
Oct-89	34	792.600368	803.122734	0.98689818	0.98892792	801.474353	824.94301	815.809179	-23.2088105	-0.028448822	0.028448822	
Nov-89	35	816.941262	801.221102	1.01962025	1.04315559	783.144209	824.96305	860.56482	-43.623558	-0.050691775	0.050691775	
Dec-89	36	941.688345	797.481225	1.18082823	1.12040636	840.488221	824.983091	924.316299	17.3720464	0.018794482	0.018794482	
Jan-90	37	832.154321	789.811307	1.05361156	1.05669817	787.50427	825.003132	871.7793	-39.6249784	-0.045452993	0.045452993	
Feb-90	38	844.324768	779.542493	1.08310294	1.07114737	788.243328	825.023172	883.721401	-39.3966329	-0.044580377	0.044580377	
Mar-90	39	871.708274	768.259474	1.13465347	1.06602123	817.72131	825.043213	879.513579	-7.80530424	-0.008874569	0.008874569	
Apr-90	40	748.482497	755.455149	0.99077026	0.98753952	757.926624	825.063253	814.782572	-66.300075	-0.081371494	0.081371494	
May-90	41	713.492462	745.439886	0.95714286	0.95281123	748.828767	825.083294	786.148631	-72.6561694	-0.092420398	0.092420398	
Jun-90	42	740.875968	738.086907	1.00377877	0.96046436	771.372681	825.103334	792.482346	-51.6063779	-0.065119909	0.065119909	
Jul-90	43	532.457061	731.621357	0.72777682	0.88087076	604.466723	825.123375	726.827054	-194.369993	-0.267422617	0.267422617	
Aug-90	44	611.564967	725.029032	0.84350411	0.90286722	677.358704	825.143416	744.994938	-133.429971	-0.179101849	0.179101849	
Sep-90	45	696.758097	719.133971	0.96888497	0.96909026	718.981629	825.163456	799.657872	-102.899775	-0.12867975	0.12867975	
Oct-90	46	637.427167	715.203931	0.89125233	0.98892792	644.563827	825.183497	816.047003	-178.619835	-0.218884249	0.218884249	
Nov-90	47	731.748133	710.259687	1.03025435	1.04315559	701.47554	825.203537	860.815686	-129.067553	-0.14993634	0.14993634	
Dec-90	48	850.409992	710.323075	1.19721578	1.12040636	759.01925	825.223578	924.585742	-74.17575	-0.080225929	0.080225929	
Jan-91	49	768.259474	719.704461	1.06746521	1.05669817	727.037763	825.243618	872.033422	-103.773948	-0.11900226	0.11900226	
Feb-91	50	750.003803	735.551397	1.0196484	1.07114737	700.187317	825.263659	883.978998	-133.975195	-0.151559251	0.151559251	
Mar-91	51	824.547792	749.686865	1.09985626	1.06602123	773.481588	825.2837	879.769943	-55.2221509	-0.062768854	0.062768854	
Apr-91	52	701.322015	761.286822	0.92123231	0.98753952	710.171085	825.30374	815.020063	-113.698048	-0.139503373	0.139503373	
May-91	53	641.991085	773.647432	0.82982384	0.95281123	673.786226	825.323781	786.37777	-144.386685	-0.183609825	0.183609825	
Jun-91	54	813.898651	780.810248	1.04237701	0.96046436	847.4012	825.343821	792.713325	21.1853257	0.026725078	0.026725078	
Jul-91	55	684.58765	784.613512	0.87251575	0.88087076	777.1715	825.363862	727.038892	-42.4512421	-0.058389231	0.058389231	
Aug-91	56	839.760851	794.185062	1.05738686	0.90286722	930.10449	825.383902	745.212066	94.5487849	0.126875005	0.126875005	
Sep-91	57	807.813427	800.967551	1.00854701	0.96909026	833.579138	825.403943	799.890926	7.92250146	0.009904477	0.009904477	
Oct-91	58	804.770815	800.967551	1.00474834	0.98892792	813.781061	825.423984	816.284827	-11.5140117	-0.014105385	0.014105385	
Nov-91	59	861.059133	807.306325	1.06658291	1.04315559	825.436913	825.444024	861.066551	-0.00741759	-8.61442E-06	8.61442E-06	
Dec-91	60	893.006557	808.257141	1.10485452	1.12040636	797.038103	825.464065	924.855185	-31.8486281	-0.03443634	0.03443634	
Jan-92	61	816.941262	802.869183	1.01752724	1.05669817	773.107483	825.484105	872.287544	-55.3462813	-0.063449584	0.063449584	
Feb-92	62	931.039204	781.634288	1.19114427	1.07114737	869.198049	825.504146	884.236595	46.802609	0.052929962	0.052929962	
Mar-92	63	806.292121	742.016947	1.08662225	1.06602123	756.356534	825.524186	880 026307	-73.7341856	-0.083786343	0.083786343	
Apr-92	64	719.577685	723.000624	0.99526565	0.98753952	728.6571	825.544227	815.257553	-95.6798675	-0.117361522	0.117361522	
May-92	65	775.866003	734.283642	1.05662983	0.95281123	814.29141	825.564268	786.606908	-10.7409051	-0.01365473	0.01365473	
Jun-92	66	702.843321	737.643193	0.95282289	0.96046436	731.774494	825.584308	792.944304	-90.1009832	-0.113628388	0.113628388	
Jul-92	67	666.331979	727.754705	0.91559969	0.88087076	756.446927	825.604349	727.25073	-60.9187506	-0.083765816	0.083765816	
Aug-92	68	348.379049	751.271558	0.4637192	0.90286722	385.858565	825.624389	745.429194	-397.050145	-0.532646358	0.532646358	
Sep-92	69	348.379049	767.562209	0.45387728	0.96909026	359.490815	825.64443	800.123979	-451.74493	-0.564593666	0.564593666	
Oct-92	70	807.813427	768.132698	1.05165869	0.98892792	816.857738	825.66447	816.522651	-8.70922412	-0.010666237	0.010666237	
Nov-92	71	1128.80897	784.486737	1.43891403	1.04315559	1082.10988	825.684511	861.317416	267.491554	0.310560949	0.310560949	
Dec-92	72	705.885932	801 474653	0.88073394	1.12040636	630.026712	825.704552	925.124628	-219.238695	-0.236982876	0.236982876	
Jan-93	73	766.738168	822.07567	0.93268563	1.05669817	725.598084	825.724592	872.541666	-105.803498	-0.121258963	0.121258963	

Month	Period	Y (kWhr)	MA	YMA	S	Y/S	T	Y=T*S	Error	Percent Error	Absolute Value	
Feb-93	74	1545.64678	855.481012	1.80675756	1.07114737	1442.98238	825.744633	884.494192	661.152591	0.747492293	0.747492293	
Mar-93	75	582.660155	902.134392	0.64586847	1.06602123	546.574627	825.764673	880.282671	-297.622515	-0.338098801	0.338098801	
Apr-93	76	956.901404	928.376919	1.03072511	0.98753952	968.975298	825.784714	815.495043	141.406361	0.173399412	0.173399412	
May-93	77	931.039204	926.031572	1.00540763	0.95281123	977.149692	825.804754	786.836047	144.203157	0.183269637	0.183269637	
Jun-93	78	955.380098	933.194387	1.02377394	0.96046436	994.706455	825.824795	793.175283	162.204815	0.204500592	0.204500592	
Jul-93	79	908.219616	956.647853	0.94937715	0.88087076	1031.04752	825.844836	727.462568	180.757048	0.248476081	0.248476081	
Aug-93	80	908.219616	942.575774	0.96355077	0.90286722	1005.92823	825.864876	745.646321	162.573295	0.218030036	0.218030036	
Sep-93	81	908.219616	932.497122	0.97396506	0.96909026	937.187844	825.884917	800.357033	107.862583	0.134768083	0.134768083	
Oct-93	82	877.793498	946.949528	0.92696968	0.98892792	887.621308	825.904957	816.760475	61.0330226	0.07472573	0.07472573	
Nov-93	83	1002.54058	1047.35572	0.95721116	1.04315559	961.06524	825.924998	861.568281	140.9723	0.163622899	0.163622899	
Dec-93	84	1004.06189	1139.14117	0.88142007	1.12040636	896.158685	825.945038	925.394071	78.6678158	0.085010071	0.085010071	
Jan-94	85	1031.44539	1123.16746	0.91833625	1.05669817	976.102185	825.965079	872.795788	158.649605	0.181771735	0.181771735	
Feb-94	86	943.209651	1110.23636	0.84955752	1.07114737	880.560115	825.98512	884.751789	58.4578624	0.066072613	0.066072613	
Mar-94	87	943.209651	1098.95334	0.85827998	1.06602123	884.794436	826.00516	880.539035	62.6706162	0.071173013	0.071173013	
Apr-94	88	943.209651	1089.88889	0.86541817	0.98753952	955.110786	826.025201	815.732533	127.477118	0.156273181	0.156273181	
May-94	89	3354.47949	1077.08457	3.11440678	0.95281123	3520.61286	826.045241	787.065186	2567.4143	3.262009737	3.262009737	
Jun-94	90	734.790744	1067.00592	0.6886473	0.96046436	765.036971	826.065282	793.406262	-58.6155176	-0.073878315	0.073878315	
Jul-94	91	745.439886	1053.25078	0.70775156	0.88087076	846.253412	826.085322	727.674406	17.76548	0.024414051	0.024414051	
Aug-94	92	760.652944	1031.19184	0.73764446	0.90286722	842.485951	826.105363	745.863449	14.7894956	0.019828691	0.019828691	
Sep-94	93	784.993839	1014.45748	0.77380655	0.96909026	810.031704	826.125404	800.590086	-15.5962473	-0.01948094	0.01948094	
Oct-94	94	783.472533	998.103439	0.78496126	0.98892792	792.244322	826.145444	816.998299	-33.5257667	-0.041035296	0.041035296	
Nov-94	95	789.557756	877.413171	0.89986996	1.04315559	756.893566	826.165485	861.819146	-72.26139	-0.083847511	0.083847511	
Dec-94	96	975.157075	762.681352	1.27859043	1.12040636	870.360177	826.185525	925.663514	49.4935609	0.053468199	0.053468199	
Jan-95	97	730.226827	755.7087	0.96628083	1.05669817	691.045795	826.205566	873.04991	-142.823083	-0.163590972	0.163590972	
Feb-95	98	715.013768	747.468293	0.95658073	1.07114737	667.521377	826.225606	885.009386	-169.995618	-0.192083407	0.192083407	
Mar-95	99	769.78078	739.925152	1.04034952	1.06602123	722.106427	826.245647	880.795399	-111.014619	-0.126039054	0.126039054	
Apr-95	100	724.141603	732.9525	0.9879789	0.98753952	733.278604	826.265688	815.970024	-91.8284206	-0.112538963	0.112538963	
May-95	101	676.981121	729.783112	0.92764701	0.95281123	710.509172	826.285728	787.294324	-110.313204	-0.140116854	0.140116854	
Jun-95	102	658.72545	722.430134	0.9118189	0.96046436	685.840597	826.305769	793.637241	-134.911791	-0.16999176	0.16999176	
Jul-95	103	654.161532	718.500094	0.91045434	0.88087076	742.630545	826.325809	727.886243	-73.7247112	-0.101286035	0.101286035	
Aug-95	104	654.161532	725.789685	0.90131004	0.90286722	724.537918	826.34585	746.080577	-91.9190443	-0.12320257	0.12320257	
Sep-95	105	710.44985	728.45197	0.97528716	0.96909026	733.110089	826.36589	800.823139	-90.3732893	-0.112850497	0.112850497	
Oct-95	106	690.672874	728.832296	0.94764307	0.98892792	698.405674	826.385931	817.236124	-126.56325	-0.15486742	0.15486742	
Nov-95	107	806.292121	730.353602	1.103975	1.04315559	772.935626	826.405972	862.070012	-55.7778904	-0.064702274	0.064702274	
Dec-95	108	781.951227	732.38201	1.06768219	1.12040636	697.917521	826.426012	925.932957	-143.98173	-0.155499088	0.155499088	
Jan-96	109	829.111709	735.995112	1.12651796	1.05669817	784.624913	826.446053	873.304032	-44.1923223	-0.050603594	0.050603594	
Feb-96	110	791.079062	741.066131	1.06748781	1.07114737	738.53429	826.466093	885.266982	-94.1879202	-0.106394932	0.106394932	
Mar-96	111	757.610333	746.010375	1.01554932	1.06602123	710.689725	826.486134	881.051763	-123.44143	-0.140106899	0.140106899	
Apr-96	112	745.439886	753.236578	0.98964908	0.98753952	754.845621	826.506174	816.207514	-70.7676284	-0.086702986	0.086702986	
May-96	113	692.194179	758.054047	0.91311983	0.95281123	726.47567	826.526215	787.523463	-95.3292833	-0.121049452	0.121049452	
Jun-96	114	692.194179	759.068251	0.91189979	0.96046436	720.687002	826.546256	793.86822	-101.674041	-0.128074204	0.128074204	
Jul-96	115	707.407238			0.88087076	803.077217	826.566296	728.098081	-20.6908429	-0.028417659	0.028417659	
Aug-96	116	722.620297			0.90286722	800.361653	826.586337	746.297704	-23.677407	-0.031726491	0.031726491	
Sep-96	117	760.652944			0.96909026	784.914442	826.606377	801.056193	-40.4032484	-0.050437471	0.050437471	
Oct-96	118	813.898651			0.98892792	823.011091	826.626418	817.473948	-3.57529722	-0.004373592	0.004373592	
Nov-96	119	798.685592			1.04315559	765.64378	826.646458	862.320877	-63.6352851	-0.073795366	0.073795366	
Dec-96	120	813.898651			1.12040636	726.431661	826.666499	926.2024	-112.303749	-0.121251844	0.121251844	MAPE
Jan-97	121									Sum=	15.37921262	0.128160107
Feb-97	122											
Mar-97	123											
Apr-97	124											
May-97	125											
Jun-97	126											
Jul-97	127											
Aug-97	128											
Sep-97	129											
Oct-97	130											
Nov-97	131											
Dec-97	132											

	Seasonality Calculations											
Month/Year	87	88	89	90	91	92	93	94	95	96	Mod Avg	Adj Avg
Jan		1.13759287	1.16089214	1.05361156	1.06746521	1.01752724	0.93286563	0.91633825	0.96628083	1.126517957	1.046280558	1.05668817
Feb		1.08162961	1.05106778	1.08310294	1.0196484	1.18114427	1.80875756	0.84955752	0.95855073	1.067487811	1.060587308	1.07114737
Mar		1.03518116	1.12540491	1.12465347	1.09985626	1.08662225	0.84586847	0.85627988	1.04034952	1.015549324	1.055511702	1.066021228
Apr		1.03535243	0.92535472	0.99077026	0.92123231	0.99526565	1.02072511	0.86541617	0.9879789	0.989649079	0.977803722	0.987539524
May		0.90678733	0.91377171	0.95714286	0.82382384	1.0956293	1.00540763	1.11440678	0.92764701	0.913119826	0.943417806	0.952811234
Jun		0.91178029	0.97465706	1.00377877	1.04237791	0.95282289	1.02377394	0.6586473	0.9118189	0.911899791	0.950995482	0.96046436
Jul	0.88921561	0.87822654	0.81052058	0.72777682	0.87251575	0.81595969	0.94937715	0.70775158	0.91045434		0.872186567	0.88087076
Aug	0.92605634	0.89606827	0.90289208	0.84350411	1.05738586	0.4837192	0.96355077	0.73764446	0.90131004		0.893966168	0.902867216
Sep	0.95386424	0.92568031	1.0534099	0.96888497	1.00854701	0.49397728	0.97396506	0.77580855	0.97528716		0.959536347	0.969090265
Oct	1.02963291	1.04778533	0.98689818	0.89135233	1.00474834	1.05169583	0.92696968	0.78496126	0.94764307		0.979178435	0.988927925
Nov	1.01558231	1.03231764	1.01962025	1.03025435	1.06658291	1.43891403	0.95731116	0.89886398	1.103875		1.032871492	1.043155593
Dec	1.10487751	1.08856089	1.18082823	1.19721578	1.10485452	0.88073394	0.88142007	1.27859043	1.06768219		1.109360667	1.120406356
											11.88169625	12





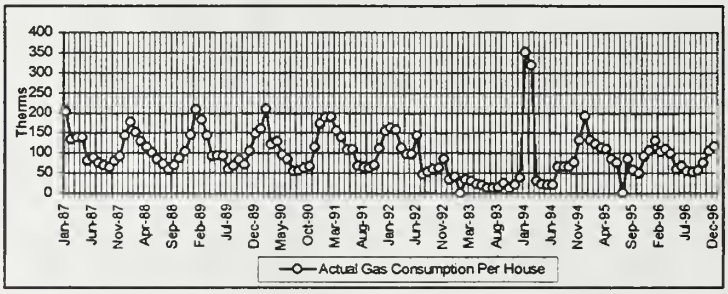


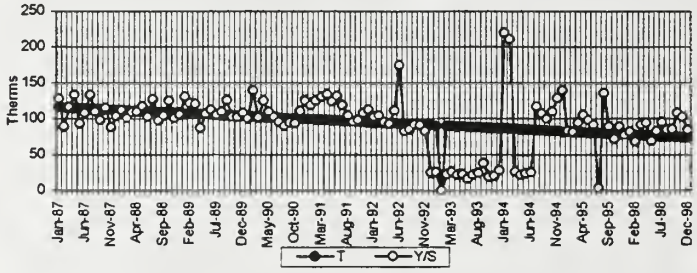
APPENDIX C. LA MESA VILLAGE GAS CONSUMPTION PER HOUSE (AVERAGE)

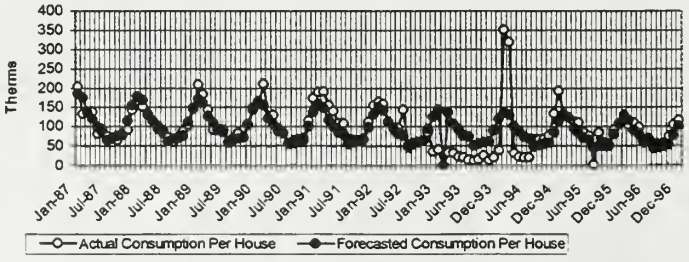
Month	Period	Y	MA	Y/MA	S	Y/S	T	Y=T*S	Error	Percent Error	Absolute	Regression Output	
Jan-87	1	204.828625			1.59672706	128.280299	116.110184	185.396273	19.4323519	0.10481522	0.10481522	Intercept	116.464535
Feb-87	2	134.665997			1.51305989	89.0024233	115.755833	175.145509	-40.4795114	-0.23111932	0.23111932	X Variable 1	-0.3543508
Mar-87	3	138.940867			1.19155073	116.605079	115.401482	137.50672	1.43414663	0.010429648	0.01042965		
Apr-87	4	138.940867			1.04215661	133.320526	115.047132	119.897128	19.0437386	0.158833964	0.15883398		
May-87	5	81.6180609			0.87050034	93.7599417	114.692781	99.8401045	-18.2220435	-0.18251226	0.18251226		
Jun-87	6	88.87469			0.82023724	108.35242	114.33843	93.7846385	-4.90994849	-0.05235344	0.05235344		
Jul-87	7	75.958803	108.474181	0.70024777	0.56840697	133.634539	113.984079	64.7893446	11.1694584	0.172396533	0.17239653		
Aug-87	8	68.976009	108.131253	0.63789152	0.6241227	110.516744	113.629728	70.9188932	-1.94288422	-0.02739586	0.02739586		
Sep-87	9	65.2640226	108.514749	0.60142997	0.66126378	98.6958978	113.275378	74.9049046	-9.64088194	-0.12870829	0.12870829		
Oct-87	10	81.3290128	107.149377	0.7590246	0.70126909	115.974045	112.921027	79.1880258	2.140987	0.027036752	0.02703675		
Nov-87	11	91.5674015	107.008656	0.85570088	1.03005322	88.8957966	112.566676	115.949667	-24.3822655	-0.21028319	0.21028319		
Dec-87	12	143.748193	107.678031	1.33498163	1.38065237	104.116139	112.212325	154.926212	-11.1780187	-0.0721506	0.0721506		
Jan-88	13	178.783868	107.324327	1.66582799	1.59672706	111.96896	111.857974	178.606655	0.17721316	0.000992198	0.0009922		
Feb-88	14	152.480489	106.821029	1.42743888	1.51305989	100.776241	111.503624	168.711661	-16.2311717	-0.09620658	0.09620658		
Mar-88	15	130.330276	106.649882	1.22203863	1.19155073	109.378705	111.149273	132.439997	-2.10972131	-0.01592964	0.01592964		
Apr-88	16	114.782529	107.109443	1.07163782	1.04215661	110.139425	110.794922	115.46566	-0.68313063	-0.00591631	0.00591631		
May-88	17	102.399099	107.927145	0.94877984	0.87050034	117.632464	110.440571	96.1385546	6.26054479	0.065120022	0.06512002		
Jun-88	18	84.1586418	108.547077	0.77531928	0.82023724	102.602805	110.08622	90.2968179	-6.13817611	-0.06797777	0.06797777		
Jul-88	19	72.1859644	109.903575	0.6568118	0.56840697	126.996974	109.73187	62.3723591	9.81360535	0.157339012	0.15733901		
Aug-88	20	60.6696789	112.473948	0.53941095	0.6241227	97.2079345	109.377519	68.2649927	-7.59531385	-0.11126221	0.11126221		
Sep-88	21	69.4628269	114.367973	0.60736258	0.66126378	105.045564	109.023168	72.0930724	-2.63024552	-0.03648403	0.03648403		
Oct-88	22	88.1596763	113.995254	0.77336269	0.70126909	125.714476	108.668817	76.2060827	11.9535936	0.156858785	0.15685879		
Nov-88	23	104.361584	112.643193	0.92647928	1.03005322	101.316691	108.314466	111.569665	-7.20808088	-0.0646061	0.0646061		
Dec-88	24	145.832383	112.60516	1.29507726	1.38065237	105.625707	107.960116	149.055389	-3.22300645	-0.02162288	0.02162288		
Jan-89	25	209.255625	112.442254	1.86100525	1.59672706	131.052845	107.605765	171.817037	37.4385882	0.217897997	0.217898		
Feb-89	26	183.697686	112.255894	1.63641908	1.51305989	121.408073	107.251414	162.277813	21.4198729	0.13199508	0.13199508		
Mar-89	27	144.569699	113.157268	1.27759977	1.19155073	121.329034	106.897063	127.373273	17.1964252	0.135008112	0.13500811		
Apr-89	28	91.5978276	113.053946	0.81021345	1.04215661	87.8925749	106.542712	111.034192	-19.4363641	-0.17504846	0.17504846		
May-89	29	93.1343465	112.429576	0.82837941	0.87050034	106.989443	106.188362	92.4370047	0.69734179	0.007543968	0.00754397		
Jun-89	30	92.5106111	112.637488	0.8213128	0.82023724	112.785187	105.834011	86.8089972	5.70161387	0.065679988	0.06567999		
Jul-89	31	59.924239	110.719375	0.54122631	0.56840697	105.424885	105.47966	59.9553736	-0.03113458	-0.0005193	0.0005193		
Aug-89	32	68.458765	109.797717	0.62349898	0.6241227	109.68799	105.125309	65.6110922	2.84767283	0.043402308	0.04340231		
Sep-89	33	83.3067105	109.98788	0.75741718	0.66126378	125.981057	104.770958	69.2812402	14.0254702	0.20244254	0.20244254		
Oct-89	34	71.8360641	110.642676	0.64926181	0.70126909	102.437231	104.416608	73.2241396	-1.38807548	-0.01895653	0.01895653		
Nov-89	35	105.700333	112.382669	0.94053944	1.03005322	102.616381	104.062257	107.189663	-1.48932955	-0.01389434	0.01389434		
Dec-89	36	149.483517	112.17032	1.33264768	1.38065237	108.270206	103.707906	143.184566	6.29895087	0.043991829	0.04399183		
Jan-90	37	159.569775	111.609339	1.42971705	1.59672706	99.9355359	103.353555	165.027419	-5.45764406	-0.03307114	0.03307114		
Feb-90	38	211.263749	110.874675	1.90542835	1.51305989	139.626825	102.999204	155.843965	55.4197833	0.355610711	0.35561071		
Mar-90	39	121.567554	109.504866	1.11015664	1.19155073	102.024656	102.644854	122.30655	-0.73899645	-0.00604217	0.00604217		
Apr-90	40	130.315062	108.400017	1.20216828	1.04215661	125.043647	102.290503	106.602723	23.7123391	0.222436522	0.22243652		
May-90	41	96.1769583	108.52806	0.88619439	0.87050034	110.484688	101.936152	88.7354549	7.44150342	0.08386167	0.08386167		
Jun-90	42	84.3716246	109.91752	0.76759032	0.82023724	102.862465	101.581801	83.3211766	1.050448	0.012607215	0.01260722		
Jul-90	43	54.5996684	112.183632	0.48669906	0.56840697	96.0573526	101.22745	57.538388	-2.93871966	-0.05107407	0.05107407		
Aug-90	44	56.1514004	112.553182	0.49888772	0.6241227	89.9685272	100.8731	62.9571917	-6.80579129	-0.10810189	0.10810189		
Sep-90	45	62.7386549	113.112896	0.55465519	0.66126378	94.8768957	100.518749	66.4694081	-3.7307532	-0.05612737	0.05612737		
Oct-90	46	65.8877581	114.953676	0.57316791	0.70126909	93.9550294	100.164398	70.2421964	-4.35443838	-0.06199177	0.06199177		
Nov-90	47	114.721677	115.847443	0.99028234	1.03005322	111.374514	99.8100473	102.809661	11.9120165	0.115864759	0.11586476		
Dec-90	48	173.809198	117.338957	1.48125739	1.38065237	125.889183	99.4556965	137.313743	36.4954552	0.26578152	0.26578152		
Jan-91	49	189.630779	118.871673	1.59525625	1.59672706	118.762175	99.1013457	158.237801	31.3929784	0.198391145	0.19839114		
Feb-91	50	190.071958	119.787626	1.58674117	1.51305989	125.620908	98.7469949	149.410118	40.66184	0.272149173	0.27214917		
Mar-91	51	156.192476	120.184433	1.29960654	1.19155073	131.083362	98.3926441	117.239827	38.952649	0.332247582	0.33224758		
Apr-91	52	139.868863	120.334662	1.16233229	1.04215661	134.210984	98.0382933	102.171255	37.6976084	0.368964914	0.36896491		
May-91	53	108.07357	120.337197	0.89808947	0.87050034	124.151095	97.6839425	85.033905	23.0396653	0.27094681	0.27094681		
Jun-91	54	108.27134	119.452938	0.90639328	0.82023724	132.000029	97.3295917	79.833356	28.4379842	0.35621682	0.35621682		
Jul-91	55	67.4851292	117.634344	0.5736856	0.56840697	118.726781	96.9752409	55.1214025	12.3637268	0.224299931	0.22429993		
Aug-91	56	65.2488096	115.273784	0.56603338	0.6241227	104.544842	96.6208901	60.3032911	4.94551845	0.082010755	0.08201076		
Sep-91	57	63.1646205	112.202014	0.56295443	0.66126378	95.5210647	96.2665393	63.6575759	-0.49295538	-0.00774386	0.00774386		
Oct-91	58	69.0672874	108.648497	0.63569482	0.70126909	98.4889941	95.9121885	67.2602533	1.80703406	0.026866299	0.0268663		
Nov-91	59	111.603	106.417249	1.04873037	1.03005322	108.346829	95.5578377	98.4296584	13.1733416	0.133835084	0.13383508		
Dec-91	60	155.705658	107.451103	1.44908385	1.38065237	112.776874	95.203487	131.442919	24.2627383	0.18458764	0.18458764		
Jan-92	61	164.088053	108.095122	1.51799683	1.59672706	102.765248	94.8491362	151.448183	12.6398706	0.083460035	0.08346003		
Feb-92	62	158.961252	106.734821	1.48931015	1.51305989	105.059458	94.4947854	142.97627	15.9849823	0.111801646	0.11180165		
Mar-92	63	113.580698	106.112354	1.07038148	1.19155073	95.3217476	94.1404346	112.173103	1.40759441	0.012548413	0.01254841		
Apr-92	64	97.1962332	105.788442	0.91877932	1.04215661	93.2645177	93.7860838	97.7397868	-0.54355357	-0.00556123	0.00556123		
May-92	65	97.1962332	104.501671	0.93009262	0.87050034	111.655595	93.431733	81.3323552	15.8638781	0.195050027	0.19505003		
Jun-92	66	143.961176	98.3948955	1.46309598	0.82023724	175.511631	93.0773822	76.3455353	67.615641	0.88565285	0.88565285		
Jul-92	67	47.2517609	88.2275012	0.53556726	0.56840697	83.130158	92.7230314	52.704417	-5.45265604	-0.10345729	0.10345729		
Aug-92	68	52.8349535	77.8731129	0.67847491	0.6241227	84.6547534	92.3686806	57.6493906	-4.81443708	-0.08351237	0.08351237		
Sep-92	69	60.6392527	69.2092759	0.87617233	0.66126378	91.7020626	92.0143298	60.8457437	-0.20649098	-0.00339368	0.00339368		
Oct-92	70	63.818782	62.6562508	1.01855411	0.70126909	91.0046983	91.659979	64.2783102	-0.45952812	-0.00714904	0.00714904		
Nov-92	71	85.9689958	56.2940228	1.52714252	1.03005322	83.4607321	91.3056282	94.0496563	-8.0806605	-0.08591909	0.08591909		
Dec-92	72	34.7770526	47.6041968	0.73054594	1.38065237	25.1888553	90.9512774	125.572096	-90.7950436	-0.72305111	0.72305111		
Jan-93	73	40.9991937	40.7095117	1.00711583	1.59672706	25.6770206	90.5969266	144.658565	-103.659371	-0.71657956	0.71657956		

Month	Period	Y	MA	Y/MA	S	Y/S	T	Y=T*S	Error	Percent Error	Absolute	
Feb-93	74	33.5447949	37.6897195	0.89002506	1.51305989	22.1701698	90.2425758	136.542422	-102.997627	-0.75432694	0.75432694	
Mar-93	75	31.0650663	34.6356979	0.89690891	1.19155073	26.0711236	89.888225	107.10638	-76.0413136	-0.70996064	0.70996064	
Apr-93	76	22.4392619	31.0460499	0.72277349	1.04215661	21.5315642	89.5338742	93.3083185	-70.8690567	-0.75951488	0.75951488	
May-93	77	19.2597326	26.2209748	0.73451627	0.87050034	22.1248996	89.1795234	77.6308053	-58.3710727	-0.75190606	0.75190606	
Jun-93	78	13.3418526	23.6658147	0.56376055	0.82023724	16.265846	88.8251726	72.8577147	-59.515862	-0.81687797	0.81687797	
Jul-93	79	12.398643	36.7972201	0.3369451	0.56840697	21.8129681	88.4708218	50.2874314	-37.8887884	-0.7534445	0.7534445	
Aug-93	80	15.2130589	61.6572599	0.24673589	0.6241227	24.375109	88.116471	54.9954901	-39.7824312	-0.72337625	0.72337625	
Sep-93	81	24.9646296	73.5519703	0.33941483	0.66126378	37.7529064	87.7621202	58.0339115	-33.0692819	-0.56962687	0.56962687	
Oct-93	82	13.3418526	73.5513365	0.18139511	0.70126909	19.0252969	87.4077694	61.296367	-47.9545144	-0.78233861	0.78233861	
Nov-93	83	20.6441209	73.6058499	0.28046848	1.03005322	20.0418003	87.0534166	89.6696541	-69.0255332	-0.76977584	0.76977584	
Dec-93	84	38.7780871	73.9614552	0.5243013	1.38065237	28.0867857	86.6990678	119.701273	-80.9231859	-0.67604282	0.67604282	
Jan-94	85	352.151887	76.528025	4.60160689	1.59672706	220.546075	66.344717	137.868946	214.282941	1.554250948	1.55425095	
Feb-94	86	319.033058	80.9417137	3.94151598	1.51305989	210.852894	85.9903662	130.108575	188.924483	1.45205252	1.45205252	
Mar-94	87	31.0498532	84.8058307	0.36612875	1.19155073	26.0583561	85.6360154	102.039656	-70.9898033	-0.69570798	0.69570798	
Apr-94	88	22.4392619	89.190361	0.25158842	1.04215661	21.5315642	85.2816647	88.8768503	-66.4375884	-0.74752411	0.74752411	
May-94	89	20.5680556	96.545875	0.2130392	0.87050034	23.6278548	84.9273139	73.9292554	-53.3611998	-0.72178733	0.72178733	
Jun-94	90	20.5680556	107.655211	0.1910549	0.82023724	25.0757397	84.5729631	69.369894	-48.8018384	-0.7035017	0.7035017	
Jul-94	91	66.7701155	104.939046	0.63627523	0.56840697	117.468855	84.2166123	47.8704459	18.8996696	0.394808722	0.39480872	
Aug-94	92	66.7701155	87.633558	0.76192405	0.6241227	106.982353	83.8642615	52.3415896	14.4285259	0.275660828	0.27566083	
Sep-94	93	66.1463801	82.8712367	0.79818261	0.66126378	100.030248	83.5099107	55.2220794	10.9243007	0.19782487	0.19782487	
Oct-94	94	77.3888306	89.9243911	0.86059888	0.70126909	110.355399	83.1555599	58.3144239	19.0744067	0.327095861	0.32709586	
Nov-94	95	133.129478	96.2878869	1.38261917	1.03005322	129.245243	82.8012091	85.289652	47.8398264	0.56091009	0.56091009	
Dec-94	96	192.9168	101.302491	1.90436382	1.38065237	139.728729	82.4468583	113.83045	79.0863499	0.694773235	0.69477324	
Jan-95	97	132.825217	100.914558	1.31621462	1.59672706	83.1859247	82.0925075	131.079328	1.7458888	0.01331933	0.01331933	
Feb-95	98	123.028007	98.9901064	1.24283135	1.51305989	81.3107318	81.7381567	123.674727	-0.64671952	-0.0052292	0.0052292	
Mar-95	99	112.759192	99.4515692	1.13381009	1.19155073	94.6323055	81.3838059	96.9729331	15.7862594	0.162790367	0.16279037	
Apr-95	100	110.005629	98.0373886	1.12207833	1.04215661	105.555756	81.0294551	84.445382	25.5602469	0.302683773	0.30268377	
May-95	101	85.7255868	95.2198033	0.90029158	0.87050034	98.4785221	80.6751043	70.2277056	15.4978813	0.220680444	0.22068044	
Jun-95	102	75.7610333	89.9459429	0.84229517	0.82023724	92.364781	80.3207535	65.8820734	9.87895988	0.149949135	0.14994913	
Jul-95	103	2.26674577	66.3030492	0.02626496	0.56840697	3.98789232	79.9664027	45.4534604	-43.1867146	-0.9501304	0.9501304	
Aug-95	104	85.0866384	85.4048449	0.99627414	0.6241227	136.329984	79.6120519	49.687689	35.3989493	0.712428974	0.71242897	
Sep-95	105	58.904964	84.4673401	0.6973697	0.66126378	89.0793744	79.2577011	52.4102472	6.49471683	0.123920744	0.12392074	
Oct-95	106	50.6899122	83.8695937	0.60438962	0.70126909	72.2831119	78.9033503	55.3324808	-4.64256855	-0.08390313	0.08390313	
Nov-95	107	92.2063499	82.3305392	1.11995319	1.03005322	89.5161028	78.5489995	80.9096498	11.2967001	0.139621171	0.13962117	
Dec-95	108	107.267278	80.9632655	1.32488824	1.38065237	77.693184	78.1946487	107.959627	-0.69234846	-0.00641303	0.00641303	
Jan-96	109	131.045289	82.8255975	1.58218345	1.59672706	82.0711894	77.8402979	124.28971	6.75557898	0.05435	0.05435	
Feb-96	110	103.251031	83.6566108	1.2342244	1.51305989	68.2398833	77.4859471	117.240879	-13.9898483	-0.11933	0.11933	
Mar-96	111	110.036055	82.22278	1.33826726	1.19155073	92.3469328	77.1315963	91.9062097	18.1298452	0.19726	0.19726	
Apr-96	112	98.3828518	83.1767656	1.18281651	1.04215661	94.403136	76.7772455	80.0139137	18.3689382	0.22957	0.22957	
May-96	113	60.4110569	84.7963225	0.71242543	0.87050034	69.3980654	76.4228947	66.5261557	-6.11509688	-0.09192	0.09192	
Jun-96	114	68.2609952	85.787073	0.79570258	0.82023724	83.2210386	76.0685439	62.3942527	5.86674249	0.09403	0.09403	
Jul-96	115	54.4627508			0.56840697	95.8164732	75.7141931	43.0364748	11.426276	0.26550	0.26550	
Aug-96	116	52.8349535			0.6241227	84.6547534	75.3598424	47.0337885	5.80116501	0.12334	0.12334	
Sep-96	117	56.7447097			0.66126378	85.8125172	75.0054916	49.598415	7.14629464	0.14408	0.14408	
Oct-96	118	75.7458202			0.70126909	108.012489	74.6511408	52.3505376	23.3952826	0.44690	0.44690	
Nov-96	119	106.019807			1.03005322	102.926534	74.29679	76.5296477	29.4901597	0.38534	0.38534	
Dec-96	120	117.231832			1.38065237	84.9104632	73.9424392	102.088804	15.1430283	0.14833	0.14833	MAPE
Jan-97	121				1.59672706		73.5880884	117.500092		Sum =	31.6470175	0.26372515
Feb-97	122				1.51305989		73.2337376	110.807031				
Mar-97	123				1.19155073		72.8793868	86.8394863				
Apr-97	124				1.04215661		72.525036	75.5824454				
May-97	125				0.87050034		72.1706852	62.8246059				
Jun-97	126				0.82023724		71.8163344	58.9064321				
Jul-97	127				0.56840697		71.4619836	40.6194893				
Aug-97	128				0.6241227		71.1076328	44.379888				
Sep-97	129				0.66126378		70.753282	46.7865828				
Oct-97	130				0.70126909		70.3989312	49.3685945				
Nov-97	131				1.03005322		70.0445804	72.1496456				
Dec-97	132				1.38065237		69.6902296	96.2179803				
Jan-98	133				1.59672706		69.3358788	110.710474				
Feb-98	134				1.51305989		68.981528	104.373184				
Mar-98	135				1.19155073		68.6271772	81.7727629				
Apr-98	136				1.04215661		68.2728264	71.1509771				
May-98	137				0.87050034		67.9184756	59.123056				
Jun-98	138				0.82023724		67.5641248	55.4186115				
Jul-98	139				0.56840697		67.209774	38.2025037				
Aug-98	140				0.6241227		66.8554232	41.7259875				
Sep-98	141				0.66126378		66.5010724	43.9747507				
Oct-98	142				0.70126909		66.1467216	46.3866514				
Nov-98	143				1.03005322		65.7923708	67.7696434				
Dec-98	144				1.38065237		65.4380201	90.3471571				

	Seasonality Calculation											
Month/Year	87	88	89	90	91	92	93	94	95	96	Med Avg	Adj Avg
Jan		1.66582799	1.86100525	1.42971705	1.59525625	1.51799683	1.00711583	4.60160689	1.31621462	1.582183446	1.55819631	1.59672706
Feb		1.42743888	1.63641908	1.90542835	1.58674117	1.48931015	0.89002506	3.94151598	1.24283135	1.234224404	1.47654812	1.51305989
Mar		1.22203863	1.27759977	1.11015664	1.29960654	1.07038148	0.89690891	0.36612875	1.13381009	1.338267265	1.16279732	1.19155073
Apr		1.07163782	0.81021345	1.20216828	1.16233229	0.91877932	0.72277349	0.25158842	1.12207833	1.182816513	1.01700824	1.04215661
May		0.94877984	0.82837941	0.88619439	0.89808947	0.93009262	0.73451627	0.2130392	0.90029158	0.712425434	0.84949422	0.87050034
Jun		0.77531928	0.8213128	0.76759032	0.90639328	1.46309598	0.56376055	0.1910549	0.84229517	0.795702579	0.80044403	0.82023724
Jul	0.70024777	0.6568118	0.54122631	0.48669906	0.5736856	0.53556726	0.3369451	0.63627523	0.02626496		0.55469069	0.56840697
Aug	0.63789152	0.53941095	0.62349898	0.49888772	0.56603338	0.67847491	0.24673589	0.76192405	0.99627414		0.60906195	0.6241227
Sep	0.60142997	0.60736258	0.75741718	0.55465519	0.56295443	0.87617233	0.33941483	0.79818261	0.6973697		0.64530677	0.66126378
Oct	0.7590246	0.77336269	0.64926181	0.57316791	0.63569482	1.01855411	0.18139511	0.86059888	0.60438962		0.68434671	0.70126909
Nov	0.85570088	0.92647928	0.94053944	0.99028234	1.04873037	1.52714252	0.28046848	1.38261917	1.11995319		1.00519692	1.03005322
Dec	1.33498163	1.29507726	1.33264768	1.48125739	1.44908385	0.73054594	0.5243013	1.90436382	1.32488824		1.34733573	1.38065237
											11.710427	12







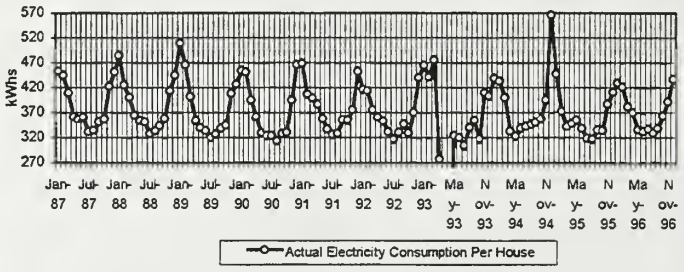
APPENDIX D. MONTEREY ELECTRICITY CONSUMPTION PER HOUSE

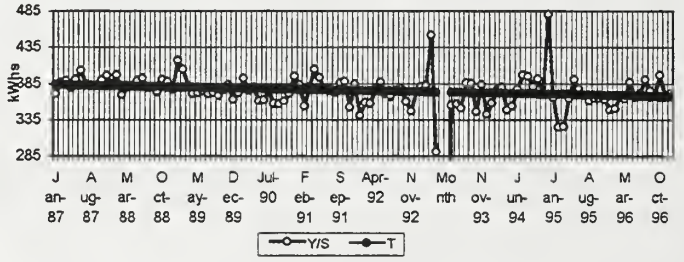
Month	Period	Y	MA	YMA	S	WS	T	Y=TS	Difference	Percent Error	Absolute	Regression Output	
Jan-87	1	452.771195			1.22062332	370.934415	383.54067	468.158684	-15.387489	-0.03286811	0.03286811	Intercept	383.678456
Feb-87	2	444.368268			1.1498853	386.445732	383.402885	440.869343	3.49892499	0.007936422	0.00793642	X Variable 1	-0.13778558
Mar-87	3	409.15638			1.05109785	389.265718	383.265099	402.849122	6.30723817	0.015656577	0.01565658		
Apr-87	4	381.586119			0.95448424	378.8288	383.127313	365.688982	4.1028637	0.01121954	0.01121954		
May-87	5	356.255464			0.911886	390.679826	382.989528	349.242788	7.01267513	0.020079656	0.02007966		
Jun-87	6	380.71152			0.89417501	403.401477	382.851742	342.336461	18.3750592	0.053675437	0.05367544		
Jul-87	7	331.757065	387.486594	0.85617689	0.86292455	384.45663	382.713957	330.25327	1.50379541	0.004553461	0.00455348		
Aug-87	8	335.05448	388.005808	0.86352933	0.87776043	381.715178	382.576171	335.810226	-0.7557457	-0.00225051	0.00225051		
Sep-87	9	351.74985	386.802977	0.90937731	0.91923897	382.653329	382.438386	351.552266	0.19758442	0.000562034	0.00056203		
Oct-87	10	358.868377	386.524871	0.92327451	0.91538065	389.857899	382.3006	349.950572	6.91780545	0.01978795	0.01976795		
Nov-87	11	422.376712	388.58658	1.09263639	1.06562078	396.366821	382.162815	407.240628	15.1380841	0.037187422	0.03716742		
Dec-87	12	451.173022	388.106072	1.16852092	1.17692292	383.349677	382.025029	449.614013	1.55900845	0.003467437	0.00346744		
Jan-88	13	484.792585	385.529603	1.25747175	1.22062332	397.168052	381.887243	466.140473	18.6521118	0.040013929	0.04001393		
Feb-88	14	424.810417	385.283772	1.10259099	1.1498853	369.437209	381.749458	438.968092	-14.157675	-0.03225217	0.03225217		
Mar-88	15	399.843859	384.901608	1.03882096	1.05109785	380.405933	381.611672	401.111209	-1.26735	-0.0031596	0.0031596		
Apr-88	18	364.219293	384.624432	0.94694789	0.95448424	381.58754	381.473887	364.110813	0.10848025	0.000297932	0.00029793		
May-88	17	354.628102	384.29467	0.92280255	0.911886	388.895215	381.336101	347.735052	6.89305034	0.019822708	0.01982271		
Jun-88	18	351.286677	383.649041	0.91564591	0.89417501	392.88121	381.198316	340.858008	10.4286688	0.030595346	0.03059535		
Jul-88	19	327.346648	384.395687	0.85158777	0.86292455	379.345819	381.06053	328.826487	-1.4798392	-0.00450036	0.00450038		
Aug-88	20	333.564956	387.134931	0.86162454	0.87776043	380.018218	380.922745	334.358913	-0.7939575	-0.00237457	0.00237457		
Sep-88	21	344.067443	388.935548	0.88463871	0.91923897	374.295973	380.784959	350.032372	-5.9649285	-0.01704108	0.01704108		
Oct-88	22	357.898568	388.620687	0.92094575	0.91538065	390.983323	380.647173	348.437057	9.46151119	0.027154147	0.02715415		
Nov-88	23	413.432224	387.590392	1.08667304	1.06562076	387.973133	380.509388	405.478702	7.95352219	0.019615142	0.01961514		
Dec-88	24	444.622411	388.26664	1.15107639	1.17692292	377.783798	380.371602	447.668058	-3.0456466	-0.00680336	0.00680338		
Jan-89	25	509.26222	385.28192	1.32179112	1.22062332	417.214888	380.233817	464.122262	45.1399575	0.097258764	0.09725876		
Feb-89	26	466.083118	384.701063	1.21154622	1.1498853	405.330093	380.096031	437.066841	29.016277	0.066388649	0.06638865		
Mar-89	27	401.785985	384.189634	1.04580121	1.05109785	382.253645	379.958246	399.373296	2.41268959	0.006041189	0.00604119		
Apr-89	28	354.720498	383.429233	0.92512637	0.95448424	371.635782	379.82046	362.532643	-7.8121465	-0.02154881	0.02154881		
May-89	29	339.399828	382.684725	0.88889149	0.911886	372.195457	379.682675	346.227315	-6.8274887	-0.01971967	0.01971967		
Jun-89	30	334.744888	381.747717	0.87687462	0.89417501	374.36171	379.544889	339.379555	-4.6346693	-0.0136563	0.0136563		
Jul-89	31	320.255175	378.744852	0.84557016	0.86292455	371.127667	379.407103	327.399705	-7.1445293	-0.02182204	0.02182204		
Aug-89	32	326.715846	375.854641	0.86926117	0.87776043	372.21528	379.269318	332.907601	-6.1917549	-0.01859902	0.01859902		
Sep-89	33	338.642264	374.981468	0.90309067	0.91923897	368.394157	379.131532	348.512477	-9.8702136	-0.02832098	0.02832098		
Oct-89	34	345.074122	375.044455	0.92008859	0.91538065	376.973363	378.993747	346.923542	-1.8494202	-0.00533092	0.00533092		
Nov-89	35	408.388487	374.987416	1.08913055	1.06562076	383.23997	378.855961	403.716776	4.6718909	0.011571704	0.0115717		
Dec-89	38	427.177985	374.118341	1.14182583	1.17692292	362.961735	378.718176	445.722102	-18.544117	-0.04160468	0.04160466		
Jan-90	37	454.633092	373.837933	1.21612349	1.22062332	372.45978	378.58039	462.104051	-7.4709592	-0.01616727	0.01616727		
Feb-90	38	451.351989	373.476707	1.20851443	1.1498853	392.519138	378.442604	435.165589	16.1863995	0.037195955	0.03719595		
Mar-90	39	395.560913	372.496309	1.06191901	1.05109785	376.331197	378.304819	397.635382	-2.0744699	-0.00521702	0.00521702		
Apr-90	40	362.457285	371.417149	0.97587655	0.95448424	379.741509	378.167033	360.954473	1.50281197	0.004163439	0.00416344		
May-90	41	329.814101	370.249863	0.89078791	0.911886	361.683479	378.029248	344.719578	-14.905477	-0.04323943	0.04323943		
Jun-90	42	323.952818	371.310299	0.87245848	0.89417501	362.292409	377.891462	337.901102	-13.948284	-0.04127919	0.04127919		
Jul-90	43	324.317459	373.474788	0.86837846	0.86292455	375.835243	377.753677	325.972922	-1.6554633	-0.00507853	0.00507853		
Aug-90	44	313.984131	372.20402	0.84358071	0.87776043	357.710508	377.615891	331.456288	-17.472157	-0.05271331	0.05271331		
Sep-90	45	327.844435	370.53108	0.88479605	0.91923897	356.64767	377.478106	346.992583	-19.148148	-0.05518316	0.05518316		
Oct-90	48	329.972111	371.705182	0.88772535	0.91538065	360.475296	377.34032	345.410028	-15.437917	-0.04469447	0.04469447		
Nov-90	47	395.475598	373.919675	1.05764854	1.06562076	371.122274	377.202534	401.95485	-6.4792518	-0.01611935	0.01611935		
Dec-90	48	485.541322	375.87821	1.23920235	1.17692292	395.558038	377.064749	443.776146	21.7651759	0.049045394	0.04904539		
Jan-91	49	468.217447	378.307093	1.24424295	1.22062332	383.588812	376.926963	460.08584	8.13160728	0.017674109	0.01767411		
Feb-91	50	407.269241	376.938496	1.08046603	1.1498853	354.18249	376.789178	433.264338	-25.995098	-0.05999824	0.05999824		
Mar-91	51	399.493112	378.64233	1.05506723	1.05109785	380.072237	376.651392	395.897469	3.59564303	0.009082258	0.00908226		
Apr-91	52	386.703524	380.843346	1.01538737	0.95448424	405.14396	376.513607	359.376303	27.3272206	0.076040686	0.07604069		
May-91	53	358.715895	381.057303	0.94136943	0.911886	393.377786	376.375821	343.211842	15.5038537	0.04517284	0.04517284		
Jun-91	54	337.256081	379.864947	0.88829923	0.89417501	377.170103	376.238036	336.422649	0.83343175	0.002477335	0.00247734		
Jul-91	55	326.107388	376.925973	0.86517622	0.86292455	377.909503	376.10025	324.54614	1.56124853	0.00481056	0.00481056		
Aug-91	56	327.347867	374.970459	0.87299642	0.87776043	372.935318	375.962464	330.004976	-2.6571092	-0.00805172	0.00805172		
Sep-91	57	355.372709	374.210845	0.94965954	0.91923897	386.594479	375.824679	345.472689	9.90001973	0.028656447	0.02865645		
Oct-91	58	355.28822	372.123019	0.95470638	0.91538065	388.109821	375.686893	343.896513	11.3717072	0.033067236	0.03306724		
Nov-91	59	375.31447	370.785246	1.01221522	1.06562076	352.202665	375.549108	400.192924	-24.878454	-0.06216615	0.06216615		
Dec-91	60	452.285891	370.32691	1.22131522	1.17692292	384.295252	375.411322	441.83019	10.4557007	0.023664523	0.02366452		
Jan-92	61	415.737503	369.729383	1.12443729	1.22062332	340.594431	375.273537	458.067628	-42.330125	-0.09241021	0.09241021		
Feb-92	62	412.816855	369.463684	1.11734082	1.1498853	359.006984	375.135751	431.363087	-18.546233	-0.04299448	0.04299448		
Mar-92	63	375.709962	369.249117	1.01749725	1.05109785	357.445276	374.997966	394.159556	-18.449594	-0.04680743	0.04680743		
Apr-92	64	360.38365	367.85286	0.97969565	0.95448424	377.56899	374.86018	357.798134	2.58551623	0.007226187	0.00722619		
May-92	65	352.929014	366.569151	0.96278973	0.911886	387.031947	374.722394	341.704105	11.2249091	0.03284973	0.03284979		
Jun-92	86	332.042694	365.825612	0.90765294	0.89417501	371.339715	374.584609	334.944196	-2.9015026	-0.00866264	0.00866264		
Jul-92	67	316.980125	367.349982	0.86288319	0.86292455	367.332375	374.446823	323.119357	-6.139232	-0.01899989	0.01899989		
Aug-92	68	330.098373	370.558076	0.89081414	0.87776043	376.068869	374.309038	328.553663	1.54470987	0.004701545	0.00470155		
Sep-92	69	347.472582	375.861838	0.92448891	0.91923897	378.000276	374.171252	343.952795	3.51978783	0.010233346	0.01023335		
Oct-92	70	329.653377	376.560759	0.8754321	0.91538065	360.127098	374.033467	342.382998	-12.729621	-0.03717948	0.03717948		
Nov-92	71	370.125095	371.900704	0.99522558	1.06562076	347.332851	373.895681	398.430998	-28.305903	-0.07104343	0.07104343		
Dec-92	72	439.630343	370.163802	1.18766433	1.17692292	373.54217	373.757895	439.884234	-0.2538918	-0.00057718	0.00057718		
Jan-93	73	464.977929	369.090751	1.25979296	1.22062332	380.934825	373.62011	456.049417	8.92851144	0.019577947	0.01957795		
Feb-93	74	440.570682	368.919185	1.19422003	1.1498853	383.143154	373.482324	429.461836	11.1088457	0.025866898	0.0258669		
Mar-93	75	475.246423	369.588474	1.28587999	1.05109785	452.142893	373.344539	392.421643	82.6247807	0.211060685	0.21106069		
Apr-93	76	277.621283	369.350078	0.7516481	0.95448424	290.859997	373.206753	356.219964	-78.598681	-0.22064648	0.22064648		

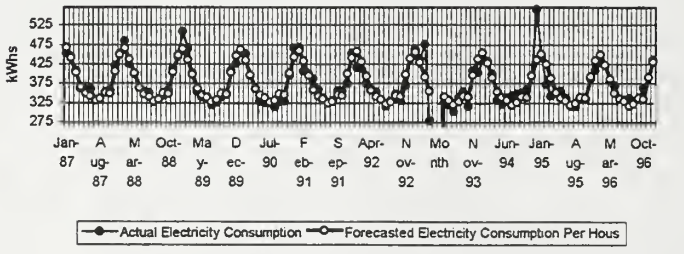
Month	Period	Y	MA	YMA	S	Y/S	T	Y-T-S	Difference	Percent Error	Absolute
May-93	77	323.850068	370.446848	0.87421468	0.911886	355.14315	373.068968	340.196368	-16.346302	-0.04804961	0.04804981
Jun-93	78	319.435991	370.56058	0.86203447	0.89417501	357.241019	372.931182	333.465744	-14.029752	-0.04207254	0.04207254
Jul-93	79	303.833604	367.925237	0.82580256	0.86292455	352.09753	372.793397	321.692575	-17.858971	-0.05551565	0.05551565
Aug-93	80	339.127324	366.479198	0.92536582	0.87776043	386.355218	372.655811	327.102351	12.0249732	0.036762112	0.03676211
Sep-93	81	354.506555	363.007026	0.97658318	0.91923897	385.652229	372.517825	342.4329	12.0736551	0.035258455	0.03525846
Oct-93	82	318.897904	362.169456	0.87499898	0.91538065	346.192487	372.38004	340.889483	-23.971579	-0.0703248	0.0703248
Nov-93	83	409.203044	364.449485	1.1227977	1.06562078	384.004386	372.242254	396.669073	12.5339713	0.031598055	0.03159806
Dec-93	84	403.281956	385.189254	1.10430948	1.17692292	342.657916	372.104469	437.938279	-34.656323	-0.07913518	0.07913518
Jan-94	85	438.078094	367.561192	1.19185078	1.22062332	358.89704	371.966683	454.031206	-15.953112	-0.0351368	0.0351368
Feb-94	86	432.785585	369.481028	1.17127959	1.1498853	376.355436	371.828898	427.580585	5.2050002	0.012173714	0.01217371
Mar-94	87	399.719398	369.615127	1.08144762	1.05109785	380.287523	371.691112	390.683729	9.03566877	0.023127835	0.02312783
Apr-94	88	333.048626	371.160788	0.89731092	0.95448424	348.928366	371.553327	354.641794	-21.595168	-0.0608929	0.0608929
May-94	89	323.145421	372.307225	0.86795366	0.911886	354.370416	371.415541	338.688632	-15.543211	-0.04589233	0.04589233
Jun-94	90	337.895086	378.493551	0.89273671	0.89417501	377.884734	371.277755	331.987291	5.90779518	0.017795245	0.01779525
Jul-94	91	342.30103	385.639826	0.88781846	0.86292455	396.675502	371.13997	320.265792	22.0352373	0.068802969	0.06880297
Aug-94	92	346.735942	383.53594	0.90405072	0.87776043	395.023435	371.002184	325.651038	21.0849035	0.064746926	0.06474693
Sep-94	93	350.116318	378.660769	0.92481735	0.91923897	380.876281	370.864399	340.913006	9.20331234	0.026996073	0.02699607
Oct-94	94	358.384004	376.919787	0.950823	0.91538065	391.513633	370.726613	339.355968	19.0280358	0.056071022	0.05607102
Nov-94	95	395.23144	378.947911	1.04297036	1.06562076	370.89315	370.588828	394.907147	0.32429275	0.000821187	0.00082119
Dec-94	96	565.725369	380.34289	1.48740882	1.17692292	480.681749	370.451042	435.992323	129.733046	0.297558097	0.2975581
Jan-95	97	447.145288	379.358485	1.17868798	1.22062332	366.32537	370.313256	452.012995	-4.8677072	-0.01076895	0.01076895
Feb-95	98	373.205135	377.114932	0.98963235	1.1498853	324.558574	370.175471	425.659334	-52.454199	-0.12323047	0.12323047
Mar-95	99	342.275737	375.264383	0.91209225	1.05109785	325.636416	370.037685	388.945816	-46.670079	-0.11999121	0.11999121
Apr-95	100	348.708717	373.648151	0.93324888	0.95448424	365.335228	369.8999	353.063625	-4.3569071	-0.01234029	0.01234029
May-95	101	356.160311	372.31239	0.95661686	0.911886	390.575479	369.762114	337.180895	18.9794161	0.056288527	0.05628853
Jun-95	102	338.359685	365.532558	0.92566224	0.89417501	378.404319	369.624329	330.508838	7.85084762	0.023753821	0.02375382
Jul-95	103	318.210713	358.310783	0.88808579	0.86292455	368.758442	369.486543	318.83901	-0.6282966	-0.00197058	0.00197058
Aug-95	104	318.980997	359.551241	0.88160173	0.87776043	361.124727	369.348758	324.199726	-7.218729	-0.0222663	0.0222663
Sep-95	105	335.458091	363.230583	0.92354032	0.91923897	364.930234	369.210972	339.393112	-3.9350212	-0.01159429	0.01159429
Oct-95	106	334.252654	365.777001	0.91381539	0.91538065	365.15154	369.073186	337.842453	-3.5897997	-0.01062566	0.01062566
Nov-95	107	387.304531	365.791113	1.0588134	1.06562076	363.45438	368.935401	393.145221	-5.8408901	-0.01485632	0.01485632
Dec-95	108	410.936294	364.66343	1.12689198	1.17692292	349.161603	368.797615	434.046367	-23.110073	-0.05324333	0.05324333
Jan-96	109	428.811772	365.187744	1.17367513	1.22062332	351.141721	368.85983	449.994784	-21.383012	-0.04751836	0.04751836
Feb-96	110	421.50965	366.495182	1.15010986	1.1498853	366.56669	368.522044	423.758083	-2.2484328	-0.00530593	0.00530593
Mar-96	111	382.275426	367.153008	1.04118833	1.05109785	363.691568	368.384259	387.207903	-4.932477	-0.01273858	0.01273858
Apr-96	112	369.821053	368.511726	1.00355301	0.95448424	387.456427	368.246473	351.485455	18.3355979	0.052166022	0.05216602
May-96	113	335.384674	389.950174	0.90656715	0.911886	367.792327	368.108688	335.673158	-0.2884847	-0.00085942	0.00085942
Jun-96	114	332.070923	371.230572	0.89451394	0.89417501	371.371286	367.970902	329.030385	3.04053818	0.009240904	0.0092409
Jul-96	115	337.083011			0.86292455	390.628601	367.833116	317.412227	19.6707834	0.061972356	0.06197236
Aug-96	116	329.48721			0.87776043	375.372593	367.695331	322.748413	6.73879658	Sum =	4.11509844
Sep-96	117	338.739716			0.91923897	368.500171	367.557545	337.873218	0.86649809		
Oct-96	118	363.580244			0.91538065	397.190222	367.41976	336.328939	27.2513052		
Nov-96	119	392.499706			1.06562076	368.329636	367.281974	391.383295	1.11641059		
Dec-96	120	436.470677			1.17692292	370.857487	367.144189	432.100411	4.37026606		
Jan-97	121				1.22062332		367.006403	447.976573			
Feb-97	122				1.1498853		366.868618	421.856832			
Mar-97	123				1.05109785		366.730832	385.46999			
Apr-97	124				0.95448424		366.593046	349.907285			
May-97	125				0.911886		366.455261	334.165422			
Jun-97	126				0.89417501		366.317475	327.551932			
Jul-97	127				0.86292455		366.17969	315.985445			
Aug-97	128				0.87776043		366.041904	321.297101			
Sep-97	129				0.91923897		365.904119	336.353323			
Oct-97	130				0.91538065		365.766333	334.815424			
Nov-97	131				1.06562076		365.628547	389.621369			
Dec-97	132				1.17692292		365.490762	430.154455			
Jan-98	133				1.22062332		365.352976	445.958361			
Feb-98	134				1.1498853		365.215191	419.955581			
Mar-98	135				1.05109785		365.077405	383.732076			
Apr-98	138				0.95448424		364.93962	348.329115			
May-98	137				0.911886		364.801834	332.657685			
Jun-98	138				0.89417501		364.664049	326.073479			
Jul-98	139				0.86292455		364.526263	314.558662			
Aug-98	140				0.87776043		364.388477	319.845788			
Sep-98	141				0.91923897		364.250692	334.833429			
Oct-98	142				0.91538065		364.112906	333.301909			
Nov-98	143				1.06562076		363.975121	387.859444			
Dec-98	144				1.17692292		363.837335	428.2085			

MAPE	
	0.03429954

Seasonality Calculations													
Month/Year	87	88	89	90	91	92	93	94	95	96	Mod Avg	Adj Avg	
Jan		1.25747175	1.32179112	1.21612349	1.24424295	1.12443726	1.26979296	1.19185078	1.17868798	1.13678127	1.21787539	1.22062392	
Feb		1.10259099	1.21154522	1.20851443	1.08045603	1.11734082	1.19422003	1.17127959	0.98983229	1.150109664	1.14710822	1.1498853	
Mar		1.03882096	1.04580121	1.06191901	1.05506723	1.01749725	1.28987569	1.08144763	0.91209229	1.041188325	1.04855936	1.05109785	
Apr		0.94694789	0.92512637	0.97587655	1.01538797	0.97969565	0.7916491	0.89731082	0.93324888	1.033558013	0.95217907	0.95448424	
May		0.92280255	0.88689149	0.89078791	0.94136943	0.90278913	0.87421468	0.89756583	0.96861686	0.906567147	0.9066371	0.911185	
Jun		0.91584581	0.87687462	0.87249848	0.88829923	0.90765294	0.86202447	0.89273871	0.92958224	0.894513943	0.89201549	0.89417901	
Jul	0.85617689	0.85158777	0.84567016	0.86837846	0.86517622	0.86288319	0.82580256	0.88761646	0.88808579		0.8609405	0.86297459	
Aug	0.86352933	0.88182454	0.86928117	0.84358071	0.87299642	0.89081414	0.93538582	0.90409072	0.88160173		0.87584058	0.8778043	
Sep	0.90937731	0.93493271	0.90309067	0.88476805	0.94986964	0.92446891	0.97658318	0.92461735	0.92354032		0.91701891	0.91923437	
Oct	0.92327451	0.92094575	0.92008859	0.88772535	0.93470838	0.8794331	0.87489598	0.950823	0.91381539		0.91318992	0.91938065	
Nov	1.09263636	1.06687304	1.08913055	1.05764854	1.01221522	0.98922596	1.1227977	1.04297038	1.0588134		1.06304718	1.06952078	
Dec	1.16852092	1.15107639	1.14182583	1.23820235	1.22131522	1.18766433	1.10430348	1.48740982	1.12889198		1.17408054	1.17982292	
											11.9710168	12	







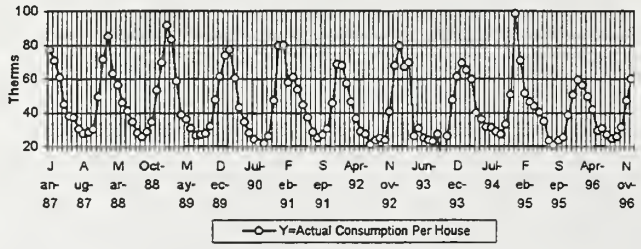
APPENDIX E. MONTEREY GAS FORECAST PER HOUSE

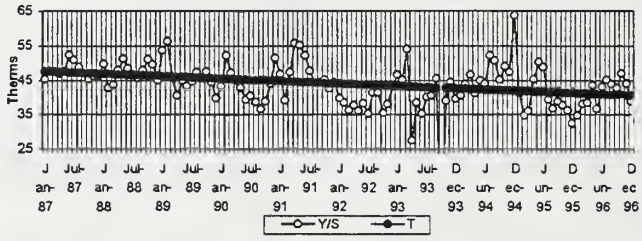
Month	Period	Y	MA	YMA	S	Y/S	T	Y/T S	Error	Percent Error	Absolute	Regression Output	
Jan-87	1	77.3295901			1.70681415	45.3063915	47.4961679	81.0671313	-3.7375413	-0.046104275	0.04610427	Intercept	47.5556389
Feb-87	2	70.8565898			1.48005532	47.7391547	47.4366969	70.2089355	0.44765434	0.006376031	0.00637603	X Variable 1	-0.059471
Mar-87	3	60.8298761			1.28400919	47.4528348	47.3772259	60.8327935	0.09708255	0.001595892	0.00159589		
Apr-87	4	44.9176099			0.96058227	46.7608153	47.3177549	45.4525962	-0.5349863	-0.011770202	0.0117702		
May-87	5	38.0753633			0.80289606	47.4225309	47.2582839	37.9434899	0.13187331	0.003475519	0.00347552		
Jun-87	6	37.2960061			0.71170691	52.4036029	47.1988129	33.5917211	3.70428501	0.110273748	0.11027375		
Jul-87	7	30.3899989	47.5454656	0.63917765	0.59742207	50.8685571	47.1383419	28.1620834	2.2279155	0.078110465	0.07911046		
Aug-87	8	27.5814753	47.5492411	0.58008132	0.56571832	48.7547857	47.0798709	26.6339453	0.94753003	0.03557803	0.03557603		
Sep-87	8	28.2841578	47.0303772	0.60140189	0.60343351	46.872037	47.0203998	28.3736847	-0.0895271	-0.003155287	0.00315528		
Oct-87	10	30.4719957	48.8753468	0.65006443	0.67175333	45.3618824	46.9609289	31.5461605	-1.0741648	-0.034050572	0.03405057		
Nov-87	11	49.3902987	47.0495575	1.04975055	1.06921609	46.1930001	46.9014578	50.1477931	-0.7574944	-0.015105239	0.01510524		
Dec-87	12	71.3729187	47.0590084	1.51666857	1.54639279	46.1544564	46.8419868	72.4361109	-1.0631821	-0.014677653	0.01467785		
Jan-88	13	85.0290037	48.8347822	1.81550975	1.70681415	49.8173768	46.7825158	79.84906	5.17994369	0.064871693	0.06487169		
Feb-88	14	63.0477874	46.8567684	1.35131084	1.48005532	42.5982642	46.7230448	89.152681	-8.1049036	-0.088281504	0.0882815		
Mar-88	15	56.0859467	46.6095934	1.20331336	1.28400919	43.6803311	46.6635738	59.9164578	-3.8305111	-0.063930866	0.06393087		
Apr-88	18	46.0408098	46.7949101	0.98388499	0.96058227	47.9301059	46.6041028	44.7670747	1.27373507	0.028452497	0.0284525		
May-88	17	41.1332189	47.1045611	0.87323219	0.80289606	51.2310633	48.5446318	37.3705015	3.76271737	0.100688831	0.10068883		
Jun-88	18	34.4648716	47.1703235	0.73064946	0.71170691	48.4257934	46.4851608	33.08381	1.38116156	0.041747355	0.04174736		
Jul-88	19	27.8396054	47.3658808	0.58775653	0.59742207	46.5895594	46.4256898	27.7357319	0.1038735	0.003745115	0.00374511		
Aug-88	20	25.8595386	48.492057	0.5332737	0.56571832	45.7109798	46.3662188	26.2302193	-0.3706807	-0.014131818	0.01413182		
Sep-88	21	28.873894	48.4448867	0.58396117	0.60343351	47.8493385	46.3067478	27.9430431	0.93085089	0.033312438	0.03331244		
Oct-88	22	34.3298596	48.2501602	0.69705072	0.67175333	51.1048593	46.2472768	31.0667624	3.26309724	0.105034995	0.105035		
Nov-88	23	52.8840578	48.7365982	1.08674097	1.06921609	49.5354107	46.1878058	49.3847449	3.57931293	0.072478109	0.07247811		
Dec-88	24	68.3774588	48.3670585	1.43439483	1.54639279	44.8640599	46.1283348	71.3325245	-1.9550657	-0.027407774	0.02740777		
Jan-89	25	81.7178339	48.1587617	1.9044495	1.70681415	53.7362747	48.0688638	78.6309886	13.0868453	0.166433687	0.16643369		
Feb-89	26	83.3871891	48.1467136	1.73193937	1.48005532	56.3405895	46.0093928	68.0864465	15.2907426	0.224545381	0.22454538		
Mar-89	27	58.6144591	48.1259707	1.21783822	1.28400919	45.6495634	45.9499218	59.000122	-0.3856629	-0.008536646	0.00853665		
Apr-89	28	38.8388605	47.9688568	0.80966825	0.96058227	40.4326229	45.8904508	44.0815532	-5.2426927	-0.118931669	0.11893167		
May-89	29	36.0096819	47.641944	0.75583989	0.80289606	44.8497429	45.8309798	36.7975131	-0.7878313	-0.021409905	0.02140991		
Jun-89	30	30.7195537	47.0764879	0.65254557	0.71170691	43.1632086	45.7715088	32.5758989	-1.8563453	-0.056985235	0.05698524		
Jul-89	31	26.6099012	45.9866034	0.57864463	0.59742207	44.5412085	45.7120378	27.3093805	-0.6994793	-0.02561315	0.02561315		
Aug-89	32	26.7760893	44.9703762	0.59541617	0.56571832	47.3311337	45.6525668	25.8264932	0.94959602	0.036768291	0.03676829		
Sep-89	33	27.459514	44.7837157	0.61315846	0.60343351	45.5054513	45.5930958	27.5124016	-0.0528877	-0.00192232	0.00192232		
Oct-89	34	31.9735057	45.0302411	0.71004518	0.67175333	47.5970927	45.5336248	30.5873643	1.38614146	0.045317454	0.04531745		
Nov-89	35	47.4745028	45.1321352	1.05190022	1.06921609	44.4012239	45.4741538	48.6216967	-1.1471939	-0.02359428	0.02359428		
Dec-89	36	61.2960687	44.9489716	1.36368122	1.54639279	39.6380977	45.4146828	70.2289382	-8.9328695	-0.12719642	0.12719642		
Jan-90	37	73.6419949	44.7318149	1.6462965	1.70681415	43.1458779	45.3552118	77.4129172	-3.7709223	-0.048711797	0.0487118		
Feb-90	38	77.0735775	44.4235843	1.73496881	1.48005532	52.0747952	45.2957408	67.0402021	10.0333755	0.149662071	0.14966207		
Mar-90	39	60.4482177	43.9911628	1.37409911	1.28400919	47.0777141	45.2362698	58.0837862	2.36443144	0.040707254	0.04070725		
Apr-90	40	42.9217116	43.5178581	0.98630564	0.96058227	44.6830148	45.1767988	43.3960317	-0.4743202	-0.010930036	0.01093004		
May-90	41	34.3722889	43.2545681	0.79485107	0.80289606	42.8103843	45.1173278	36.2245247	-1.8522358	-0.051132095	0.0511321		
Jun-80	42	27.8810212	43.9825321	0.63558563	0.71170691	39.2872698	45.0578568	32.0679879	-4.1089666	-0.128070606	0.12807061		
Jul-90	43	24.1590718	45.0022817	0.53684104	0.59742207	40.438887	44.9983858	26.883029	-2.7238572	-0.101326275	0.10132627		
Aug-90	44	21.8269835	44.4579259	0.4909582	0.56571832	38.5827767	44.9389148	25.4227872	-3.5957838	-0.141439511	0.14143951		
Sep-90	45	22.0305056	43.6725929	0.50444693	0.60343351	36.5085887	44.8794438	27.0817601	-5.0512544	-0.18651869	0.18651869		
Oct-90	46	26.0384013	44.1296233	0.59004359	0.67175333	38.7818491	44.8199728	30.1079661	-4.0695648	-0.135165716	0.13516572		
Nov-90	47	47.0954465	44.9813681	1.04699898	1.06921609	44.0467059	44.7605018	47.8586485	-0.763202	-0.015947002	0.015947		
Dec-90	48	78.3862594	45.7708783	1.73442348	1.54639279	51.3364132	44.7010308	89.1253518	10.2609076	0.148439137	0.14843914		
Jan-91	49	79.7857962	46.3327577	1.72201699	1.70681415	46.7454505	44.6415598	76.1948458	3.59095039	0.047128521	0.04712852		
Feb-91	50	57.8652364	48.6476902	1.24047378	1.48005532	39.0966714	44.5820888	65.9839576	-8.1187212	-0.123040834	0.12304083		
Mar-81	51	80.8085682	46.975797	1.29446592	1.28400919	47.3583589	44.5226178	57.1674505	3.64111769	0.063692147	0.06369215		
Apr-81	52	53.5300904	47.3488146	1.13054764	0.96058227	55.7267111	44.4631468	42.7105103	10.8195802	0.253323599	0.2533236		
May-81	53	44.2057844	47.4565383	0.9315004	0.80289606	55.0579167	44.4036758	35.6515363	8.55424809	0.239940518	0.23994052		
Jun-91	54	37.0781705	48.9348753	0.78999188	0.71170691	52.097528	44.3442048	31.5600768	5.5180937	0.174844115	0.17484412		
Jul-91	55	28.5246293	45.984379	0.62031129	0.59742207	47.7461923	44.2847338	26.4566775	2.06795174	0.078163698	0.0781637		
Aug-81	56	25.0198051	45.4398753	0.55061342	0.56571832	44.226613	44.2252628	25.0190412	0.00076386	3.05313E-05	3.0531E-05		
Sep-91	57	26.7122489	44.7966676	0.59629987	0.60343351	44.2670927	44.1657918	26.6511185	0.06112841	0.002293653	0.00229365		
Oct-91	58	30.309082	43.4767328	0.69713339	0.67175333	45.1193623	44.1063208	29.628568	0.68051402	0.022968171	0.02296817		
Nov-81	59	45.4101353	42.1174542	1.07817854	1.06921609	42.470494	44.0468497	47.0956002	-1.685465	-0.035788162	0.03578816		
Dec-81	80	68.5518585	41.0688648	1.66918805	1.54639279	44.3300427	43.9873787	68.0217655	0.52989303	0.007790051	0.00779005		
Jan-92	81	67.8084864	40.3444806	1.68037762	1.70681415	39.7281019	43.9279077	74.9767745	-7.1682881	-0.095606782	0.09560678		
Feb-82	62	56.7744579	39.8650216	1.42060371	1.48005532	38.3596864	43.8684367	64.9277131	-8.1532552	-0.125574347	0.12557435		
Mar-92	63	46.46236	39.8262225	1.16662734	1.28400919	36.1853796	43.8089657	56.2511147	-9.7887547	-0.174018857	0.17401886		
Apr-92	84	38.1878637	39.4817865	0.91682436	0.96058227	37.6832522	43.7494947	42.0249888	-5.827125	-0.138658575	0.13865857		
May-82	65	28.9153247	39.0108985	0.74121145	0.80289606	36.0137832	43.6900237	35.0785479	-6.1632233	-0.175697788	0.17569779		
Jun-82	66	27.2024858	38.7673662	0.70188517	0.71170691	38.2214722	43.6305527	31.0521657	-3.8496799	-0.123974604	0.1239746		
Jul-82	87	21.0150936	39.2098686	0.5359644	0.59742207	35.1762923	43.5710817	26.0303261	-5.0152325	-0.192668831	0.19268883		
Aug-92	88	23.4223236	40.1176806	0.58384042	0.56571832	41.4028022	43.5116107	24.6153152	-1.1929916	-0.048465421	0.04846542		
Sep-92	68	24.8785492	41.4973114	0.60193175	0.60343351	41.3940376	43.4521397	26.220477	-1.2419278	-0.047364804	0.0473648		
Oct-92	70	23.7763158	42.0421205	0.5655356	0.67175333	35.3944143	43.3926687	29.1491699	-5.3728541	-0.184322714	0.18432271		
Nov-92	71	40.6415915	41.7055235	0.97448942	1.06921609	38.0106436	43.3331977	46.332552	-5.6909605	-0.122828556	0.12282856		
Dec-82	72	67.4754251	41.6927151	1.61839844	1.54639279	43.6340789	43.2737267	66.9181791	0.55724603	0.008327274	0.00832727		
Jan-93	73	79.5047787	41.7251126	1.90544192	1.70681415	46.580806	43.2142557	73.7587031	5.74607564	0.077903697	0.0779037		
Feb-93	74	68.865654	41.8271174	1.5986197	1.48005532	45.1778073	43.1547847	63.8714686	2.99418538	0.046878292	0.04687829		
Mar-93	75	89.4823019	41.9076744	1.65798515	1.28400919	54.1135549	43.0953137	55.334779	14.147523	0.255671447	0.25567145		
Apr-93	76	26.2533416	42.1099574	0.62344735	0.96058227	27.330654	43.0358427	41.3394673	-15.086126	-0.364932756	0.36493276		
May-93	77	30.7815169	42.4889573	0.72445922	0.80289606	38.3381092	42.9763717	34.5055595	-3.7240427	-0.107925874	0.10792587		
Jun-93	78	25.0288933	42.4989631	0.5889295	0.71170691	35.1674166	42.9169007	30.5442546	-5.5153613	-0.180569518	0.18056952		
Jul-93	79	23.9662254	41.8001187	0.57335305	0.59742207	40.1160693	42.8574297	25.6039746	-1.6377492	-0.063964647	0.06396465		
Aug-83	80	22.9193078	41.284357	0.55515719	0.56571832	40.5136392	42.7979587	24.2115892	-1.2922814	-0.053374497	0.0533745		
Sep-93	81	27.4149313	40.7932215	0.67204624	0.60343351	45.4315696	42.7384877	25.7898354	1.62509584	0.063013037	0.06301304		

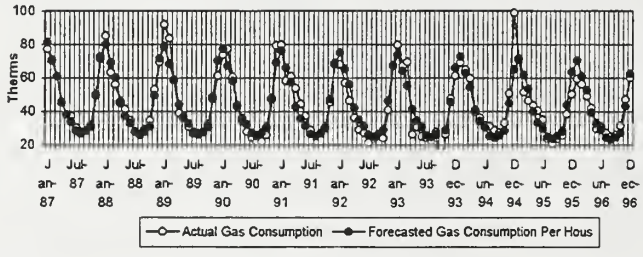
Month	Period	Y	MA	YMA	S	Y/S	T	YeT*S	Error	Percent Error	Absolute
Oct-83	82	26.194727	40.9454567	0.63974685	0.67175333	38.994562	42.6790167	28.6697718	-2.4750447	-0.086329419	0.08632942
Nov-93	83	47.3191777	41.7235084	1.1341131	1.06921609	44.2559538	42.6195457	45.5695038	1.74967386	0.038395718	0.03839572
Dec-83	84	61.0379786	42.2030346	1.4482936	1.54638279	39.4711996	42.5600747	65.8145928	-4.7766141	-0.072576824	0.07257682
Jan-94	85	68.1699584	42.7605494	1.61761155	1.70681415	40.5257705	42.5006037	72.5408317	-3.3706733	-0.046466004	0.046466
Feb-94	86	64.8221934	43.2982551	1.49710868	1.48005532	43.7971423	42.4411327	62.8152242	2.00696923	0.031950363	0.03195038
Mar-94	87	59.7385121	43.5314687	1.37230638	1.28400919	46.5249879	42.3816617	54.4184432	5.32006893	0.09776224	0.09776224
Apr-94	88	39.6507755	43.8044586	0.9051767	0.96058227	41.277855	42.3221907	40.6539458	-1.0031703	-0.024675842	0.02467584
May-94	89	36.0573242	44.2212142	0.81538521	0.80289606	44.9090809	42.2627197	33.9325711	2.12475303	0.082616818	0.06261692
Jun-94	90	31.2617143	45.8251387	0.68071029	0.71170691	43.9249837	42.2032487	30.0363436	1.22537073	0.040796268	0.04078627
Jul-94	81	31.1137584	47.5554971	0.6542621	0.59742207	52.0800296	42.1437777	25.1776231	5.93613626	0.23577032	0.23577032
Aug-94	82	28.8767112	47.0520515	0.60946782	0.58571832	50.690795	42.0843067	23.8078631	4.86884806	0.204505883	0.20450588
Sep-94	83	27.2546545	45.8168907	0.5935649	0.60343351	45.1659616	42.0248357	25.3591939	1.89546064	0.074744515	0.07474451
Oct-94	84	32.9067604	45.5116817	0.72303987	0.67175333	48.9863745	41.9653647	28.1903736	4.71638676	0.167304869	0.18730487
Nov-94	95	50.6092788	45.8535333	1.10371801	1.06821609	47.333069	41.9058937	44.8064556	5.8028232	0.129508642	0.12950864
Dec-94	88	98.6420654	46.1760136	2.13621874	1.54639279	63.7884927	41.8464227	64.7110064	33.931059	0.524347571	0.52434757
Jan-95	97	70.6944737	46.0014016	1.53678956	1.70681415	41.4189639	41.7869517	71.3225603	-0.6280867	-0.008806283	0.00880628
Feb-95	98	51.2148834	45.3524112	1.12926704	1.48005532	34.6034251	41.7274807	61.7589797	-10.543996	-0.17072815	0.17072815
Mar-95	89	46.1018624	44.8606121	1.02766905	1.28400919	35.9046202	41.6880097	53.5021074	-7.400245	-0.138316888	0.13831689
Apr-95	100	43.5624094	44.3829781	0.98151164	0.96058227	45.3500038	41.6085387	39.9684243	3.59398509	0.08992061	0.08992061
May-95	101	40.3501293	43.5868847	0.926163	0.80289608	50.2557321	41.5490677	33.3595827	6.99054658	0.209551378	0.20955138
Jun-95	102	34.7084367	41.0536178	0.84544161	0.71170691	48.7678798	41.4895967	29.5284325	5.18000424	0.175424288	0.17542429
Jul-95	103	23.4763479	38.5586506	0.60887934	0.59742207	39.2960837	41.4301257	24.7512716	-1.2749238	-0.051509425	0.05150942
Aug-95	104	20.7383535	38.2825849	0.54171769	0.56571832	36.6584444	41.3706547	23.4041371	-2.6657836	-0.11380224	0.11380224
Sep-95	105	23.389834	38.6212533	0.60562079	0.60343351	38.7612451	41.3111837	24.9285523	-1.5387183	-0.061725138	0.06172514
Oct-95	106	25.308366	38.6773701	0.65434557	0.67175333	37.675088	41.2517126	27.7109755	-2.4026095	-0.086702453	0.08670245
Nov-95	107	38.6238296	38.1435535	1.01259128	1.06921609	36.1235022	41.1922416	44.0434073	-5.4195777	-0.123050828	0.12305083
Dec-95	108	50.3067093	37.5154007	1.34096153	1.54639279	32.5316501	41.1327706	63.6074201	-13.300711	-0.209106277	0.20910628
Jan-86	109	59.1026169	37.4895386	1.57650959	1.70681415	34.6274473	41.0732996	70.104489	-11.001872	-0.156935343	0.15693534
Feb-96	110	56.2292633	37.7978697	1.48763049	1.48005532	37.9913254	41.0138286	60.7027352	-4.4734719	-0.073694734	0.07369473
Mar-96	111	49.2156256	38.0637238	1.29297979	1.28400919	38.3296521	40.9543576	52.5857717	-3.370146	-0.064088553	0.06408855
Apr-96	112	41.7954499	38.4205894	1.08783989	0.96058227	43.5105366	40.8948866	39.2829029	2.512547	0.063960319	0.06396032
May-96	113	29.3054898	39.0241065	0.75095863	0.80289606	36.4997304	40.8354156	32.7865943	-3.4811046	-0.106174632	0.10617463
Jun-96	114	30.6774094	39.7734611	0.77130349	0.71170691	43.1039928	40.7759446	29.0205214	1.65688799	0.057093667	0.05709367
Jul-96	115	26.8866838			0.59742207	45.0045034	40.7164736	24.3249202	2.56176365	0.10531437	0.10531437
Aug-96	118	24.7279638			0.56571832	43.7107357	40.6570026	23.0004111	1.72755275	0.075109647	0.07510965
Sep-96	117	25.7807234			0.60343351	42.7233874	40.5975316	24.4979108	1.28281258	0.052364162	0.05236416
Oct-96	118	31.4822491			0.67175333	46.8657877	40.5380606	27.2315774	4.25067175	0.156093483	0.15609348
Nov-96	119	46.934358			1.06921609	43.8960465	40.4785896	43.2803591	3.65399985	0.084426283	0.08442628
Dec-96	120	59.9806882			1.54639279	38.7874856	40.4191186	62.5038337	-2.5231455	-0.040367852	0.04036785
Jan-87	121				1.70681415		40.3596476	68.8864176		Sum =	11.03152131
Feb-87	122				1.48005532		40.3001766	59.6464907			
Mar-97	123				1.28400919		40.2407056	51.6694359			
Apr-97	124				0.96058227		40.1812346	38.5973814			
May-97	125				0.80289606		40.1217636	32.2136059			
Jun-97	126				0.71170691		40.0622926	28.5126103			
Jul-97	127				0.59742207		40.0028216	23.8985687			
Aug-97	128				0.56571832		39.9433506	22.5966851			
Sep-97	129				0.60343351		39.8838796	24.0672693			
Oct-97	130				0.67175333		39.8244086	26.7521792			
Nov-87	131				1.06921609		39.7649376	42.5173109			
Dec-97	132				1.54639278		39.7054666	61.4002474			
Jan-98	133				1.70681415		39.6459956	67.6683462			
Feb-98	134				1.48005532		39.5865246	58.5902463			
Mar-98	135				1.28400919		39.5270536	50.7531001			
Apr-98	138				0.96058227		39.4675826	37.9118599			
May-98	137				0.80289606		39.4081116	31.6406175			
Jun-98	138				0.71170691		39.3486406	28.0046993			
Jul-98	139				0.59742207		39.2891696	23.4722172			
Aug-98	140				0.56571832		39.2296986	22.192959			
Sep-98	141				0.60343351		39.1702276	23.6366277			
Oct-98	142				0.67175333		39.1107566	26.2727811			
Nov-98	143				1.06921609		39.0512856	41.7542627			
Dec-98	144				1.54639279		38.9918146	60.296661			

MAPE
0.04152944

Seasonality Calculations													
Month/Year	87	88	89	90	91	92	93	94	95	96	Mod Avg	Adj Avg
Jan		1.81550975	1.8044495	1.6462965	1.72201699	1.68073762	1.80544193	1.61761155	1.53979956	1.575097	1.6904144	1.70631416
Feb		1.35131064	1.3215397	1.3466981	1.24947378	1.42060371	1.5986197	1.49710868	1.1292676	1.487630487	1.4110549	1.42406532
Mar		1.20331336	1.21793822	1.37402611	1.29446592	1.16863734	1.65796515	1.37230638	1.03768385	1.29297979	1.2782923	1.28400918
Apr		0.98388499	0.80956875	0.98630564	1.13554764	0.91682436	0.82344735	0.9051767	0.98151164	0.887838884	0.9547402	0.96358227
May		0.87323219	0.75583989	0.79465107	0.8315604	0.74121149	0.72445922	0.81538521	0.926163	0.750958634	0.7989134	0.80258656
Jun		0.73064946	0.65254557	0.63568493	0.78894188	0.70168517	0.6888295	0.68071029	0.8456418	0.771303492	0.7023798	0.71170681
Jul	0.62917286	0.58775653	0.57864463	0.53884104	0.62031129	0.5326644	0.57335305	0.6542631	0.60887934		0.5937897	0.59742267
Aug	0.58006132	0.5332737	0.59541617	0.4988587	0.55061342	0.58384042	0.55515719	0.60946782	0.54171769		0.5622801	0.56771803
Sep	0.60140189	0.58395117	0.61319945	0.59444593	0.59629987	0.60193175	0.6720452	0.5935649	0.60562079		0.5997538	0.60342391
Oct	0.65006443	0.69705072	0.71804518	0.69004359	0.69713339	0.6963258	0.63974685	0.7220987	0.65434557		0.6716819	0.6775133
Nov	1.04975055	1.08674097	1.05190022	1.04699898	1.07817854	0.9744894	1.1341133	1.0331601	1.0125913		1.0627136	1.06921808
Dec	1.51666857	1.43439483	1.26358132	1.23417348	1.66918805	1.61839844	1.4462936	2.13621874	1.34896193		1.5398887	1.54835279
											11.9276243	12







APPENDIX F. MARINA ELECTRICITY FORECAST PER HOUSE

Month	Period	Y	MA	YMA	A	YS	T	Y-T*S	Error	Percent Error	Absolute
Jan-87	1	516.987744			1.22245105	422.910792	427.003968	521.991451	-5.004	-0.0095858	0.0095858
Feb-87	2	482.401124			1.11760696	431.637546	426.838317	477.037473	5.364	0.011243668	0.01124367
Mar-87	3	436.964718			1.00937636	432.905639	426.672666	430.673302	6.291	0.014608324	0.01460832
Apr-87	4	413.098868			0.94612004	436.62416	426.507015	403.526835	9.572	0.023720934	0.02372093
May-87	5	415.472018			0.88426895	469.848023	426.341364	377.00043	38.472	0.102046536	0.10204654
Jun-87	6	388.904781			0.9300544	418.152724	426.175713	396.366597	-7.462	-0.01882554	0.01882554
Jul-87	7	406.94142	436.047412	0.9332504	0.9104994	446.943095	426.010062	387.881906	19.060	0.049137414	0.04913741
Aug-87	8	376.472664	433.693817	0.86806094	0.90103313	417.82333	425.844411	383.699924	-7.227	-0.01883571	0.01883571
Sep-87	9	411.639862	433.02637	0.95061153	0.96287424	427.511553	425.67876	409.875112	1.765	0.00430558	0.00430558
Oct-87	10	446.51674	432.767987	1.03176934	0.9276534	481.340056	425.513108	394.728682	51.788	0.131199125	0.13119912
Nov-87	11	443.766432	429.333532	1.03361699	1.01402348	437.629344	425.347457	431.31231	12.454	0.028874951	0.02887495
Dec-87	12	503.76556	426.972317	1.17985532	1.17403858	429.08774	425.181806	499.179844	4.586	0.009186502	0.0091865
Jan-88	13	496.261761	426.0809	1.16471253	1.22245105	405.956344	425.016155	519.561447	-23.300	-0.04484491	0.04484491
Feb-88	14	446.640829	425.412236	1.04990123	1.11760696	399.640344	424.850504	474.815879	-28.175	-0.0593389	0.0593389
Mar-88	15	456.70629	424.263678	1.07646804	1.00937636	452.463826	424.684853	428.666851	28.039	0.065410794	0.06541079
Apr-88	16	387.156116	421.326602	0.91889787	0.94612004	409.204011	424.519202	401.646125	-14.490	-0.03607656	0.03607656
May-88	17	358.987846	418.582894	0.85762665	0.88426895	405.971335	424.353551	375.242668	-16.255	-0.04331816	0.04331816
Jun-88	18	388.719785	416.685032	0.93288637	0.9300544	417.953816	424.1879	394.517822	-5.798	-0.01469651	0.01469651
Jul-88	19	385.732397	418.948892	0.92071468	0.9104994	423.649259	424.022248	386.072003	-0.340	-0.00087965	0.00087965
Aug-88	20	381.633756	423.272115	0.90162745	0.90103313	423.551301	423.856597	381.908838	-0.275	-0.00072028	0.00072028
Sep-88	21	378.913384	423.107651	0.89554841	0.96287424	393.523233	423.690946	407.961098	-29.048	-0.07120217	0.07120217
Oct-88	22	408.75339	422.197141	0.96815765	0.9276534	440.631586	423.525295	392.884681	15.869	0.040390246	0.04039025
Nov-88	23	415.680793	423.27431	0.98206006	1.01402348	409.932117	423.359644	429.296621	-13.616	-0.0317166	0.0317166
Dec-88	24	486.302509	423.622808	1.14796111	1.17403858	414.213397	423.193993	496.846074	-10.544	-0.02122099	0.02122099
Jan-89	25	568.057459	422.894351	1.34326093	1.22245105	464.687283	423.028342	517.131443	50.926	0.098477895	0.0984779
Feb-89	26	478.602478	421.939497	1.13429172	1.11760696	428.238635	422.862691	472.594285	6.008	0.012713214	0.01271321
Mar-89	27	420.797521	421.725593	0.99779935	1.00937636	416.888624	422.69704	426.660399	-5.863	-0.01374132	0.01374132
Apr-89	28	401.212623	422.01728	0.95070188	0.94612004	424.061012	422.531389	399.765415	1.447	0.003620143	0.00362014
May-89	29	370.783412	421.546261	0.87957941	0.88426895	419.310677	422.365737	373.484906	-2.701	-0.00723321	0.00723321
Jun-89	30	385.288166	420.974384	0.91522948	0.9300544	414.264119	422.200086	392.669048	-7.381	-0.0187967	0.0187967
Jul-89	31	371.681036	418.63073	0.88784938	0.9104994	408.216673	422.034435	384.262101	-12.581	-0.03274084	0.03274084
Aug-89	32	372.76863	415.474692	0.8972114	0.90103313	413.712455	421.868784	380.117753	-7.349	-0.01933381	0.01933381
Sep-89	33	382.644811	415.400882	0.92114588	0.96287424	397.398533	421.703133	406.047084	-23.402	-0.05763438	0.05763438
Oct-89	34	412.022456	415.290997	0.99212952	0.9276534	444.155603	421.537482	391.040679	20.982	0.053656251	0.05365625
Nov-89	35	401.107285	414.344403	0.96805286	1.01402348	395.560154	421.371831	427.280931	-26.174	-0.0612563	0.0612563
Dec-89	36	487.150957	413.995633	1.17670554	1.17403858	414.936072	421.20618	494.512305	-7.361	-0.01488608	0.01488608
Jan-90	37	510.961323	414.517865	1.23266418	1.22245105	417.981007	421.040529	514.701438	-3.740	-0.00726657	0.00726657
Feb-90	38	459.953692	414.350278	1.11006005	1.11760696	411.552281	420.874877	470.372691	-10.419	-0.02215052	0.02215052
Mar-90	39	437.674862	413.675911	1.05801389	1.00937636	433.609186	420.709226	424.653947	13.021	0.030662413	0.03066241
Apr-90	40	381.69805	412.110498	0.92620317	0.94612004	403.435117	420.543575	397.884705	-16.187	-0.04068177	0.04068177
May-90	41	367.579723	410.315056	0.89584751	0.88426895	415.687697	420.377924	371.727145	-4.147	-0.01115717	0.01115717
Jun-90	42	380.121383	410.346379	0.92634273	0.9300544	408.708763	420.212273	390.820273	-10.699	-0.02737547	0.02737547
Jul-90	43	389.381389	412.002414	0.94509492	0.9104994	427.656941	420.046622	382.452198	6.929	0.018117796	0.0181178
Aug-90	44	351.046189	412.881263	0.85023521	0.90103313	389.604084	419.880971	378.326667	-27.280	-0.07210826	0.07210826
Sep-90	45	388.18244	411.96716	0.94226549	0.96287424	403.149678	419.71532	404.13307	-15.951	-0.03946876	0.03946876
Oct-90	46	368.914916	413.642855	0.89186822	0.9276534	397.686157	419.549669	389.196677	-20.282	-0.05211186	0.05211186
Nov-90	47	401.124209	415.675713	0.96499313	1.01402348	395.576844	419.384018	425.265242	-24.141	-0.056767	0.056767
Dec-90	48	487.885789	417.209314	1.16940292	1.17403858	415.561974	419.218366	492.178535	-4.293	-0.00872193	0.00872193
Jan-91	49	549.971329	417.508278	1.31727048	1.22245105	449.89231	419.052715	512.271434	37.700	0.073593592	0.07359359
Feb-91	50	442.036069	417.195333	1.05954222	1.11760696	395.520148	418.887064	468.151097	-26.115	-0.05578333	0.05578333
Mar-91	51	433.654007	419.141508	1.03462434	1.00937636	429.625682	418.721413	422.647496	11.007	0.026041823	0.02604182
Apr-91	52	425.935596	421.257156	1.0111059	0.94612004	450.191918	418.555762	396.003995	29.932	0.075584089	0.07558409
May-91	53	372.130768	422.920152	0.87990786	0.88426895	420.834372	418.390111	369.969383	2.161	0.005842063	0.00584206
Jun-91	54	412.376759	423.740891	0.97318141	0.9300544	443.389934	418.22446	388.971499	23.405	0.060172173	0.06017217
Jul-91	55	364.301146	420.649508	0.86604439	0.9104994	400.111352	418.058809	380.642295	-16.341	-0.04293046	0.04293046
Aug-91	56	368.615746	419.12902	0.87948037	0.90103313	409.10343	417.893158	376.535581	-7.920	-0.02103343	0.02103343
Sep-91	57	417.321088	418.814767	0.99643356	0.96287424	433.411832	417.727506	402.219055	15.102	0.037546786	0.03754679
Oct-91	58	390.55182	415.685901	0.93953588	0.9276534	421.010497	417.561855	387.352675	3.199	0.008258996	0.008259
Nov-91	59	419.399203	416.09666	1.00793696	1.01402348	413.599103	417.396204	423.249553	-3.850	-0.00909711	0.00909711
Dec-91	60	489.308544	416.134722	1.17584166	1.17403858	416.77382	417.230553	489.844766	-0.536	-0.00109468	0.00109468
Jan-92	61	474.355366	415.110007	1.14272207	1.22245105	388.036285	417.064902	509.841429	-35.486	-0.06960216	0.06960216
Feb-92	62	481.160327	416.387984	1.15555767	1.11760696	430.527319	416.899251	465.929503	15.231	0.032689115	0.03268912
Mar-92	63	386.987686	416.662229	0.92878034	1.00937636	383.392857	416.7336	420.641044	-33.653	-0.08000493	0.08000493
Apr-92	64	397.509126	415.515303	0.95666543	0.94612004	420.146607	416.567949	394.123285	3.386	0.008590816	0.00859082
May-92	65	410.415451	413.350383	0.99289965	0.88426895	464.129666	416.402298	368.211622	42.204	0.114618407	0.11461841
Jun-92	66	375.00556	412.498843	0.90910694	0.9300544	403.2082	416.236646	387.122724	-12.117	-0.03130057	0.03130057
Jul-92	67	377.079194	415.601959	0.90730851	0.9104994	414.145461	416.070995	378.832392	-1.753	-0.0046279	0.0046279
Aug-92	68	386.509129	417.903867	0.92487569	0.90103313	428.96217	415.905344	374.744496	11.765	0.031393745	0.03139374
Sep-92	69	406.009584	419.402814	0.96806595	0.96287424	421.664187	415.739693	400.305041	5.705	0.014250488	0.01425049

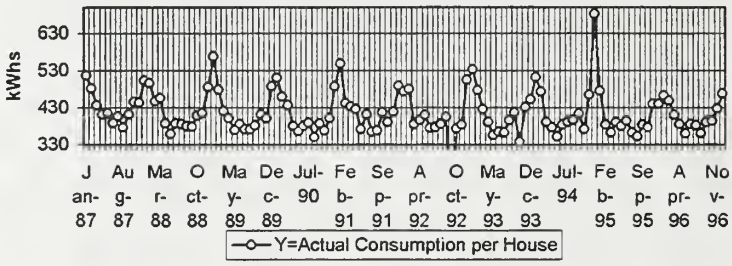
Intercept	427.16962
X Variable 1	-0.1656511

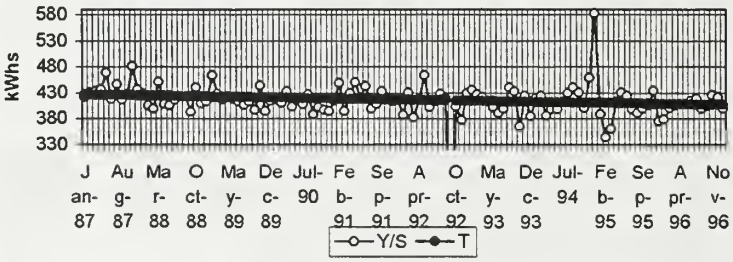
Month	Period	Y	MA	Y/MA	S	YS	T	Y=T*S	Error	Percent Error	Absolute
Oct-92	70	374.337104	420.837266	0.8895056	0.9276534	403.531215	415.574042	385.508674	-11.172	-0.02897878	0.02897878
Nov-92	71	383.655837	418.36308	0.91704038	1.01402348	378.350052	415.408391	421.233863	-37.578	-0.08920941	0.08920941
Dec-92	72	504.614955	415.66904	1.21398253	1.17403858	429.81122	415.24274	487.510996	17.104	0.035084251	0.03508425
Jan-93	73	533.523751	414.681812	1.28658585	1.22245105	436.43772	415.077089	507.411425	26.112	0.051461841	0.05146184
Feb-93	74	477.237737	414.585901	1.15111907	1.11760696	427.017507	414.911438	463.707909	13.530	0.029177477	0.02917748
Mar-93	75	426.884999	415.519185	1.02735328	1.00937636	422.919553	414.745787	418.634592	8.250	0.019707896	0.0197079
Apr-93	76	392.038658	414.528977	0.94574488	0.94612004	414.364605	414.580135	392.242575	-0.204	-0.00051988	0.00051988
May-93	77	356.505442	415.023782	0.85900003	0.88426895	403.164041	414.414484	366.45386	-9.948	-0.0271478	0.0271478
Jun-93	78	364.258633	414.832487	0.87808608	0.9300544	391.65304	414.248833	385.27395	-21.015	-0.05454643	0.05454643
Jul-93	79	364.132639	411.805919	0.88423362	0.9104994	399.92628	414.083182	377.022489	-12.890	-0.03418855	0.03418855
Aug-93	80	397.153819	410.836236	0.96669618	0.90103313	440.776042	413.917531	372.95341	24.200	0.064888557	0.06488856
Sep-93	81	417.763714	409.227124	1.02086027	0.96287424	433.871524	413.75188	398.391027	19.373	0.048627317	0.04862732
Oct-93	82	338.817988	407.105071	0.83226177	0.9276534	365.242005	413.586229	383.664672	-44.847	-0.11689031	0.11689031
Nov-93	83	431.050274	406.341383	1.06080821	1.01402348	425.089045	413.420578	419.218174	11.832	0.028224207	0.02822421
Dec-93	84	452.629438	407.053056	1.11196669	1.17403858	385.531997	413.254927	485.177227	-32.548	-0.06708433	0.06708433
Jan-94	85	512.871613	409.043783	1.2538306	1.22245105	419.543679	413.089275	504.98142	7.890	0.015624719	0.01562472
Feb-94	86	474.617496	410.169302	1.15712583	1.11760696	424.672997	412.923624	461.486316	13.131	0.028454106	0.02845411
Mar-94	87	390.886545	410.024001	0.95332601	1.00937636	387.255498	412.757973	416.62814	-25.742	-0.06178554	0.06178554
Apr-94	88	377.107836	411.290865	0.91688843	0.94612004	398.583498	412.592322	390.361865	-13.254	-0.03395319	0.03395319
May-94	89	353.107752	414.129922	0.8526497	0.88426895	399.321668	412.426671	364.696099	-11.588	-0.03177535	0.03177535
Jun-94	90	384.736489	425.179302	0.90488057	0.9300544	413.670952	412.26102	383.425175	1.311	0.003419999	0.00342
Jul-94	91	391.432214	433.227939	0.90352486	0.9104994	429.909359	412.095369	375.212587	16.220	0.043227833	0.04322783
Aug-94	92	396.866713	427.941138	0.92738622	0.90103313	440.457402	411.929718	371.162325	25.704	0.069253766	0.06925377
Sep-94	93	414.563589	423.091207	0.97984449	0.96287424	430.548011	411.764067	396.477013	18.087	0.045618221	0.04561822
Oct-94	94	372.422855	422.56665	0.88133518	0.9276534	401.467676	411.598416	381.82067	-9.398	-0.02461316	0.02461316
Nov-94	95	465.582773	424.336329	1.09720225	1.01402348	459.143976	411.432764	417.202485	48.380	0.115963568	0.11596357
Dec-94	96	683.282061	425.952724	1.60412652	1.17403858	581.992852	411.267113	482.843457	200.439	0.415121299	0.4151213
Jan-95	97	475.386279	425.205362	1.11801572	1.22245105	388.879602	411.101462	502.551416	-27.165	-0.05405444	0.05405444
Feb-95	98	385.219595	422.160113	0.91249643	1.11760696	344.682531	410.935811	459.264722	-74.045	-0.16122537	0.16122537
Mar-95	99	363.886107	419.073717	0.86831049	1.00937636	360.505874	410.77016	414.621689	-50.736	-0.12236596	0.12236596
Apr-95	100	391.51891	418.027445	0.93658662	0.94612004	413.815259	410.604509	388.481155	3.038	0.007819569	0.00781957
May-95	101	381.168973	417.191221	0.91365531	0.88426895	431.055476	410.438858	362.938337	18.231	0.050230669	0.05023067
Jun-95	102	395.468745	406.067971	0.9738979	0.9300544	425.210337	410.273207	381.576401	13.892	0.036407765	0.03640777
Jul-95	103	362.763284	395.486478	0.91725838	0.9104994	398.42232	410.107556	373.402684	-10.639	-0.0284931	0.0284931
Aug-95	104	352.449651	397.666626	0.88629427	0.90103313	391.161698	409.941904	369.371239	-16.922	-0.04581187	0.04581187
Sep-95	105	384.907159	402.272749	0.9568313	0.96287424	399.748111	409.776253	394.562999	-9.656	-0.02447224	0.02447224
Oct-95	106	376.96875	404.013398	0.93306002	0.9276534	406.3681	409.610602	379.976668	-3.008	-0.00791606	0.00791606
Nov-95	107	440.967505	402.982832	1.09425879	1.01402348	434.869125	409.444951	415.186795	25.781	0.062094242	0.06209424
Dec-95	108	440.939337	401.749178	1.09754882	1.17403858	375.574828	409.2793	480.509688	-39.570	-0.08235079	0.08235079
Jan-96	109	463.773162	402.164226	1.15319348	1.22245105	379.379739	409.113649	500.121412	-36.348	-0.07267885	0.07267885
Feb-96	110	449.156261	403.345417	1.1135772	1.11760696	401.891074	408.947998	457.043128	-7.887	-0.01725629	0.01725629
Mar-96	111	410.496405	403.94549	1.01621733	1.00937636	406.683198	408.782347	412.615237	-2.119	-0.00513513	0.00513513
Apr-96	112	386.684184	404.946151	0.95490273	0.94612004	408.705203	408.616696	386.600445	0.084	0.000216602	0.0002166
May-96	113	361.270115	405.181636	0.8916251	0.88426895	408.552303	408.451045	361.180576	0.090	0.000247907	0.00024791
Jun-96	114	385.759906	405.83875	0.95052507	0.9300544	414.771336	408.285393	379.727626	6.032	0.015885806	0.01588581
Jul-96	115	382.433271			0.9104994	420.025835	408.119742	371.592781	10.840	0.029173038	0.02917304
Aug-96	116	361.128244			0.90103313	400.793523	407.954091	367.580153	-6.452	-0.01755239	0.01755239
Sep-96	117	390.630321			0.96287424	405.691943	407.78844	392.648984	-2.019	-0.00514114	0.00514114
Oct-96	118	395.26144			0.9276534	426.087415	407.622789	378.132667	17.129	0.045298317	0.04529832
Nov-96	119	428.326465			1.01402348	422.402905	407.457138	413.171106	15.155	0.036680588	0.03668059
Dec-96	120	469.351118			1.17403858	399.774868	407.291487	478.175919	-8.825	-0.01845513	0.01845513
Jan-97	121				1.22245105		407.125836	497.691407		Sum =	4.95763322
Feb-97	122				1.11760696		406.960185	454.821534			
Mar-97	123				1.00937636		406.794533	410.608785			
Apr-97	124				0.94612004		406.628882	384.719735			
May-97	125				0.88426895		406.463231	359.422814			
Jun-97	126				0.9300544		406.29758	377.878852			
Jul-97	127				0.9104994		406.131929	369.782878			
Aug-97	128				0.90103313		405.966278	365.789068			
Sep-97	129				0.96287424		405.800627	390.73497			
Oct-97	130				0.9276534		405.634976	376.288665			
Nov-97	131				1.01402348		405.469325	411.155417			
Dec-97	132				1.17403858		405.303673	475.842149			
Jan-98	133				1.22245105		405.138022	495.261403			
Feb-98	134				1.11760696		404.972371	452.59994			
Mar-98	135				1.00937636		404.80672	408.602333			
Apr-98	136				0.94612004		404.641069	382.839025			
May-98	137				0.88426895		404.475418	357.665053			
Jun-98	138				0.9300544		404.309767	376.030077			

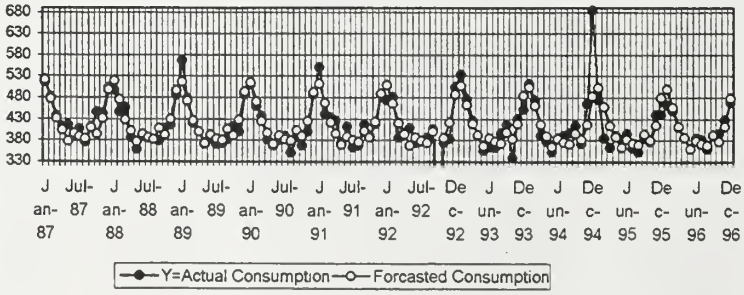
MAPE
0.04139694

Month	Period	Y	MA	YMA	S	Y/S	T	Y=T*S	Error
Jul-98	139				0.9104994		404.144116	367.972975	
Aug-98	140				0.90103313		403.978465	363.997982	
Sep-98	141				0.96287424		403.812814	388.820956	
Oct-98	142				0.9276534		403.647162	374.444663	
Nov-98	143				1.01402348		403.481511	409.139727	
Dec-98	144				1.17403858		403.31586	473.50838	

	Seasonality											
Month/Year	87	88	89	90	91	92	93	94	95	96	Medial Avg	Adj Avg
Jan		1.16471253	1.34326093	1.23266418	1.21727048	1.14272207	1.28658585	1.2538306	1.118015719	1.153193478	1.21819733	1.22245105
Feb		1.04990123	1.13429172	1.11006005	1.05954222	1.19559767	1.15111907	1.15712583	0.912496429	1.113577202	1.11371805	1.11760696
Mar		1.07546504	0.99779935	1.05801389	1.03462434	0.92878024	1.02735328	0.95332601	0.968310439	1.016217325	1.00586406	1.00937636
Apr		0.91883787	0.95070188	0.92620317	1.0111059	0.95586543	0.94574488	0.91688543	0.936586617	0.954902728	0.94282786	0.94612004
May		0.89762665	0.87957941	0.89584751	0.87990786	0.89383959	0.85900003	0.8526497	0.913655306	0.891625096	0.88119198	0.88426895
Jun		0.93288637	0.91522948	0.92634273	0.97315141	0.90910694	0.87808606	0.90483057	0.9738979	0.950525068	0.92681812	0.9300544
Jul	0.9332594	0.92071468	0.88784938	0.94509462	0.88604439	0.90730851	0.88423362	0.90352486	0.917258375		0.90733116	0.9104994
Aug	0.88826094	0.90162745	0.8972114	0.85973521	0.87948037	0.92487569	0.96863618	0.92738822	0.886294267		0.89789784	0.90103313
Sep	0.95061153	0.8955484	0.92114988	0.94226549	0.99643356	0.96806595	1.02286027	0.97984449	0.956831302		0.95952375	0.96287424
Oct	1.03176234	0.96815765	0.98212352	0.89186822	0.93953588	0.8895056	0.83226177	0.88133515	0.933060022		0.92442547	0.9276534
Nov	1.03361699	0.98206006	0.96805286	0.96499313	1.00793696	0.91704038	1.06080821	1.09720225	1.094254756		1.01049501	1.01402348
Dec	1.17985532	1.14796111	1.17670554	1.16940292	1.17584166	1.21398293	1.14196659	1.16412662	1.097548821		1.16995331	1.17403858
											11.9582439	12





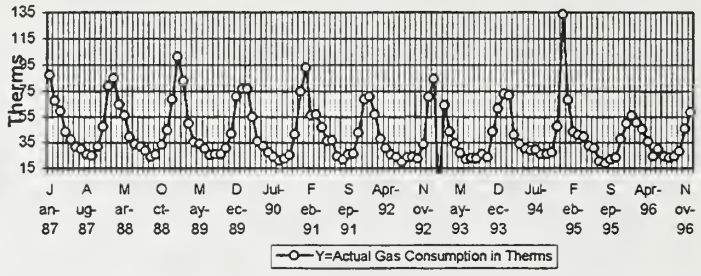


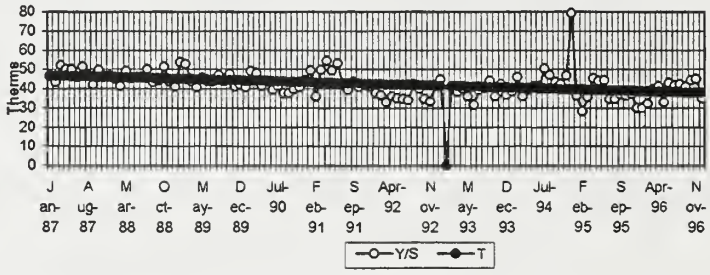
APPENDIX G. MARINA GAS FORECAST PER HOME

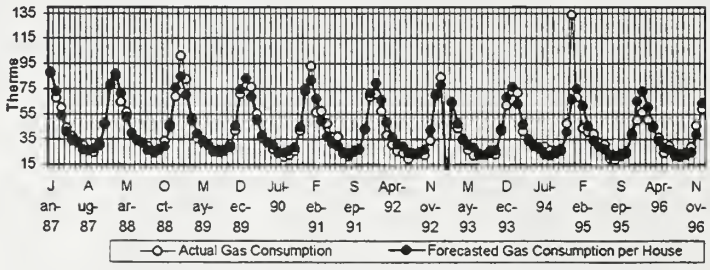
Month	Period	Y	MA	YMA	S	YS	T	YeTS	Error	Percent Error	Absolute	Regression Output	
Jan-87	1	87.3342049			1.68583153	46.3107141	46.8466635	88.3449152	-1.0107103	-0.0114405	0.0114405	Intercept	46.8221884
Feb-87	2	67.4704621			1.55987266	43.2538269	46.7711401	72.9570229	-5.48656075	-0.07520264	0.07520264	X Variable 1	0.07952337
Mar-87	3	59.8111721			1.14889704	52.059645	46.6956168	53.6484559	6.16271618	0.1148722	0.1148722		
Apr-87	4	43.7617801			0.87120925	50.2310782	46.6200934	40.6158567	3.14592339	0.077455547	0.07745555		
May-87	5	37.3439943			0.74332677	50.239001	46.54457	34.5978249	2.74616945	0.079374049	0.07937405		
Jun-87	6	32.2263355			0.69866306	46.1257185	46.4690467	32.4662062	-0.23987071	-0.00738832	0.00738832		
Jul-87	7	30.1108529	47.2300899	0.63753537	0.58424909	51.5376973	46.3935233	27.1053739	3.00547898	0.110881296	0.1108813		
Aug-87	8	26.1082262	47.0121567	0.55535053	0.55634799	46.9278704	46.3179999	25.7689259	0.33930022	0.01316703	0.01316703		
Sep-87	9	25.0646474	46.7488035	0.53615591	0.59611973	42.046331	46.2424766	27.5660525	-2.50140516	-0.09074223	0.09074223		
Oct-87	10	32.2119295	46.4313581	0.69375377	0.64909242	49.6261066	46.1669532	29.9666193	2.24531022	0.074927045	0.07492704		
Nov-87	11	47.7616266	46.1311879	1.03534352	1.02490295	46.6011212	46.0914298	47.2392424	0.52238422	0.011058268	0.01105827		
Dec-87	12	78.7471597	45.9968697	1.71201128	1.68148751	46.8318434	46.0159065	77.375172	1.37198771	0.017731627	0.01773163		
Jan-88	13	84.9515808	45.954449	1.84860405	1.88583153	45.0472799	45.9403831	86.635823	-1.68424221	-0.01944048	0.01944048		
Feb-88	14	64.6226872	45.8343271	1.40991897	1.55987266	41.4281811	45.8648597	71.5433408	-6.92065362	-0.09673372	0.09673372		
Mar-88	15	56.3384717	45.7983404	1.23014221	1.14889704	49.0370065	45.7893364	52.607233	3.73123865	0.070926343	0.07092634		
Apr-88	16	39.6157895	45.8944262	0.86319392	0.87120925	45.4721864	45.713813	39.8262968	-0.21050736	-0.00528564	0.00528564		
May-88	17	34.2859019	45.8247379	0.74819636	0.74332677	46.1249391	45.6382896	33.9241624	0.36173956	0.010663183	0.01066318		
Jun-88	18	32.0607903	45.2981033	0.70777335	0.69866306	45.8887727	45.5627662	31.8330216	0.22776869	0.007155107	0.00715511		
Jul-88	19	29.2583026	45.5694402	0.64205973	0.58424909	50.0784732	45.4872429	26.5758804	2.68242218	0.100934462	0.10093446		
Aug-88	20	24.0778495	46.9970875	0.51232642	0.55634799	43.2783979	45.4117195	25.2647187	-1.1868692	-0.04697734	0.04697734		
Sep-88	21	26.2313433	47.4894034	0.55236203	0.59611973	44.0034813	45.3361961	27.0258009	-0.79445762	-0.02939627	0.02939627		
Oct-88	22	33.3512936	47.0624485	0.7086604	0.64909242	51.3814252	45.2606728	29.3783595	3.97293402	0.135233352	0.13523335		
Nov-88	23	44.9497434	46.8778735	0.95886908	1.02490295	43.8575607	45.1851494	46.3103929	-1.36064954	-0.02938108	0.02938108		
Dec-88	24	68.9198123	46.8025327	1.47256587	1.68148751	40.9874066	45.109626	75.8512728	-6.93146049	-0.09138226	0.09138226		
Jan-89	25	101.291014	46.5829052	2.17442459	1.88583153	53.7115923	45.0341027	84.9267308	16.3642835	0.192687077	0.19268708		
Feb-89	26	82.5467886	46.5179983	1.77451291	1.55987266	52.9189277	44.9585793	70.1296588	12.4171298	0.177059607	0.17705961		
Mar-89	27	50.2299511	46.6021607	1.07784597	1.14889704	43.7201501	44.8830559	51.5660102	-1.33605909	-0.02590969	0.02590969		
Apr-89	28	35.4773933	46.4934051	0.76306292	0.87120925	40.7220117	44.8075326	39.036737	-3.55934362	-0.09117933	0.09117933		
May-89	29	33.9944974	46.2710323	0.73468206	0.74332677	45.7329115	44.7320092	33.2504999	0.74399747	0.022375527	0.02237553		
Jun-89	30	30.5440152	46.2172071	0.66087973	0.69866306	43.7178048	44.6564858	31.1998369	-0.65582174	-0.02102004	0.02102004		
Jul-89	31	25.5040186	45.2613559	0.56348331	0.58424909	43.6526456	44.5809625	26.0463869	-0.54236828	-0.02082317	0.02082317		
Aug-89	32	26.2743682	43.9869545	0.59732183	0.55634799	47.2265002	44.5054391	24.7605114	1.51385685	0.061139967	0.06113997		
Sep-89	33	26.0547222	43.9515519	0.59280551	0.59611973	43.7071966	44.4299157	26.4855493	-0.43082711	-0.0162665	0.0162665		
Oct-89	34	30.9177792	44.1893496	0.69966586	0.64909242	47.6323222	44.3543924	28.7900998	2.12767939	0.073903161	0.07390316		
Nov-89	35	42.04631	44.1596458	0.95214328	1.02490295	41.0246746	44.278869	45.3815434	-3.33523344	-0.07349317	0.07349317		
Dec-89	36	70.5314419	43.9842965	1.60355962	1.68148751	41.9458613	44.2033456	74.3273736	-3.79593174	-0.05107044	0.05107044		
Jan-90	37	76.7389558	43.8027443	1.75192119	1.88583153	40.6923707	44.1278223	83.2176387	-6.47868284	-0.07785228	0.07785228		
Feb-90	38	76.5132131	43.5253912	1.75789834	1.55987266	49.0509353	44.0522989	68.7159768	7.79723632	0.113470501	0.1134705		
Mar-90	39	55.4138651	43.1579196	1.28397906	1.14889704	48.2322289	43.9767755	50.5247873	4.88907783	0.096765926	0.09676593		
Apr-90	40	36.0006232	42.7927149	0.84127925	0.87120925	41.3225905	43.9012522	38.2471771	-2.24655389	-0.05873777	0.05873777		
May-90	41	32.7583767	42.5658423	0.76959306	0.74332677	44.0699542	43.8257288	32.5768374	0.1815393	0.00557265	0.00557265		
Jun-90	42	27.5717535	42.7378853	0.64513612	0.69866306	39.4635915	43.7502054	30.5666523	-2.99489878	-0.09797929	0.09797929		
Jul-90	43	24.119028	43.59929	0.55319772	0.58424909	41.2820975	43.6746821	25.5168934	-1.39786538	-0.05478196	0.05478196		
Aug-90	44	21.0028836	43.4320391	0.48358042	0.55634799	37.751343	43.5991587	24.2563041	-3.25342047	-0.1341268	0.1341268		
Sep-90	45	22.5068888	42.6560822	0.5276361	0.59611973	37.7556516	43.5236353	25.9452976	-3.43840889	-0.13252532	0.13252532		
Oct-90	46	25.7006999	43.1978752	0.59495287	0.64909242	39.5948237	43.448112	28.2018401	-2.50114018	-0.08868713	0.08868713		
Nov-90	47	41.818445	43.8322908	0.95405566	1.02490295	40.8023462	43.3725886	44.452694	-2.63424898	-0.0592596	0.0592596		
Dec-90	48	74.8883395	44.3954902	1.68684565	1.68148751	44.5369585	43.2970652	72.8034744	2.08486508	0.02863689	0.02863689		
Jan-91	49	93.055772	44.8026825	2.0770134	1.88583153	49.3446898	43.2215419	81.5085465	11.5472255	0.141668892	0.14166889		
Feb-91	50	56.1823745	44.8447234	1.25282018	1.55987266	36.0172826	43.1460185	67.3022947	-11.1199202	-0.16522349	0.16522349		
Mar-91	51	57.1217374	45.0284601	1.26856964	1.14889704	49.718761	43.0704951	49.4835644	7.63817296	0.154357776	0.15435778		
Apr-91	52	47.2957833	45.220702	1.04588786	0.87120925	54.2875126	42.9949717	37.4576172	9.83816606	0.262647942	0.26264794		
May-91	53	36.6891919	45.3098641	0.80973962	0.74332677	49.3580932	42.9194484	31.9031749	4.78601704	0.150016951	0.15001695		
Jun-91	54	37.1577236	45.1089293	0.82373322	0.69866306	53.1840394	42.843925	29.9334677	7.22425593	0.24134377	0.24134377		
Jul-91	55	24.3056742	43.9416625	0.55313506	0.58424909	41.6015608	42.7684016	24.9873999	-0.68172569	-0.02728278	0.02728278		
Aug-91	56	21.825219	43.0615248	0.50683804	0.55634799	39.2294383	42.6928783	23.7520968	-1.92687783	-0.08112454	0.08112454		
Sep-91	57	26.0942323	42.3054902	0.61680487	0.59611973	43.7734756	42.6173549	25.405046	0.68918633	0.027127931	0.02712793		
Oct-91	58	26.727162	40.8418256	0.65440664	0.64909242	41.1762043	42.5418315	27.6135803	-0.88641831	-0.03210081	0.03210081		
Nov-91	59	42.9318735	39.7300741	1.08058881	1.02490295	41.8887208	42.4663082	43.5238445	-0.59197103	-0.01360107	0.01360107		
Dec-91	60	68.9524772	38.7424466	1.77976569	1.68148751	41.0068328	42.3907848	71.2795752	-2.32709799	-0.03264747	0.03264747		
Jan-92	61	70.9772311	38.0117333	1.86724532	1.88583153	37.6371006	42.3152614	79.7994543	-8.82222316	-0.11055493	0.11055493		
Feb-92	62	57.1376091	37.897956	1.50766994	1.55987266	36.6296625	42.2397381	65.8886127	-8.75100359	-0.13281511	0.13281511		
Mar-92	63	38.0216731	37.8783329	1.00378423	1.14889704	33.0940648	42.1642147	48.4423415	-10.4206684	-0.21511488	0.21511488		
Apr-92	64	31.267897	37.6104154	0.83136271	0.87120925	35.890226	42.0886913	36.6680573	-5.40016033	-0.14727151	0.14727151		
May-92	65	26.0350415	37.0723176	0.70227715	0.74332677	35.0250288	42.013168	31.2295124	-5.19447089	-0.16633212	0.16633212		
Jun-92	66	24.1088146	36.7758571	0.65556092	0.69866306	34.5070694	41.9376446	29.300283	-5.19146842	-0.17718151	0.17718151		
Jul-92	67	19.8174635	37.3909288	0.53000726	0.58424909	33.9195452	41.8621212	24.4579064	-4.64044284	-0.18973181	0.18973181		
Aug-92	68	23.5827761	38.228585	0.61688854	0.55634799	42.3885351	41.7865979	23.2478895	0.33488655	0.01440503	0.01440503		
Sep-92	69	23.8657201	38.7611062	0.61571308	0.59611973	40.035112	41.7110745	24.8647944	-0.99907429	-0.04018028	0.04018028		
Oct-92	70	22.525654	39.1512259	0.5753499	0.64909242	34.7033079	41.6355511	27.0253206	-4.49966654	-0.16649817	0.16649817		
Nov-92	71	34.2190341	39.3319157	0.8700068	1.02490295	33.3875848	41.5600278	42.594995	-8.3759609	-0.1966419	0.1966419		
Dec-92	72	70.5502646	39.2836392	1.79591978	1.68148751	41.9570553	41.4845044	69.755676	0.79458851	0.011391023	0.01139102		
Jan-93	73	84.1411645	39.3308064	2.13931958	1.88583153	44.6175403	41.408981	78.0903621	6.05080232	0.077484624	0.07748462		

Month	Period	Y	MA	Y/MA	S	Y/S	T	T*S	Error	Percent Error	Absolute	
Feb-93	74	64.0774259	39.4151837	1.62570411	1.55987266	41.0786262	41.3334577	64.4749306	-0.3975047	-0.00616526	0.00616526	
Mar-93	75	43.8623647	39.4672981	1.1113597	1.14889704	38.1778028	41.2579343	47.4011186	-3.53875392	-0.07465549	0.07465549	
Apr-93	76	34.7900779	39.598496	0.87857069	0.87120925	39.9330905	41.1824109	35.8784974	-1.08841953	-0.03033626	0.03033626	
May-93	77	26.8494161	40.0201736	0.67089704	0.74332677	36.1206097	41.1068876	30.5558499	-3.70643382	-0.1213003	0.1213003	
Jun-93	78	22.1358025	40.0451211	0.55277152	0.69866306	31.683087	41.0313642	28.6670984	-6.5312959	-0.22783247	0.22783247	
Jul-93	79	22.9224902	39.210453	0.58460151	0.58424909	39.2341049	40.9558408	23.9284129	-1.00592265	-0.04203884	0.04203884	
Aug-93	80	22.5028026	39.0575784	0.57614434	0.55634799	40.4473516	40.8803175	22.7436823	-0.24087968	-0.01059106	0.01059106	
Sep-93	81	26.1964397	39.2676215	0.6671257	0.59611973	43.9449299	40.8047941	24.3245427	1.87189692	0.076955071	0.07695507	
Oct-93	82	23.3436853	39.138865	0.59643235	0.64909242	35.9635772	40.7292707	26.4370608	-3.09337552	-0.11700906	0.11700906	
Nov-93	83	43.5212634	39.278527	1.10801669	1.02490295	42.4637898	40.6537474	41.6661456	1.85511784	0.044523385	0.04452339	
Dec-93	84	61.8467775	39.7215143	1.55700956	1.68148751	36.7809913	40.578224	68.2317768	-6.3849993	-0.09357809	0.09357809	
Jan-94	85	72.812616	40.2761552	1.80783433	1.88583153	38.6103502	40.5027006	76.38127	-3.568654	-0.04672159	0.04672159	
Feb-94	86	71.7369835	40.6980885	1.76266223	1.55987266	45.9889997	40.4271772	63.0612486	8.67573486	0.137576325	0.13757633	
Mar-94	87	41.2438419	40.8379967	1.00993793	1.14889704	35.8986405	40.3516539	46.3598957	-5.11605389	-0.11035516	0.11035516	
Apr-94	88	34.3184438	40.9980582	0.83707486	0.87120925	39.3917348	40.2761305	35.0889376	-0.77049375	-0.02195831	0.02195831	
May-94	89	30.6729393	41.3459182	0.74186136	0.74332677	41.2644082	40.2006071	29.8821874	0.79075182	0.026462314	0.02646231	
Jun-94	90	28.9439753	44.512728	0.65024043	0.69866306	41.4276595	40.1250838	28.0339137	0.91006156	0.032462879	0.03246288	
Jul-94	91	29.4256979	47.3201766	0.62184252	0.58424909	50.3649868	40.0495604	23.3989194	6.02677851	0.257566532	0.25756653	
Aug-94	92	26.1259955	45.975948	0.56825355	0.55634799	46.9598097	39.974037	22.239475	3.88652053	0.174757747	0.17475775	
Sep-94	93	25.9310415	44.8076774	0.57871871	0.59611973	43.4997204	39.8985137	23.7842911	2.14675039	0.090259171	0.09025917	
Oct-94	94	27.4505607	45.0128032	0.60983895	0.64909242	42.2906814	39.8229903	25.8488011	1.60175957	0.061966494	0.06196649	
Nov-94	95	47.7630273	45.3133676	1.05406042	1.02490295	46.6024879	39.7474669	40.7372961	7.02573119	0.172464347	0.17246435	
Dec-94	96	133.608451	45.4909846	2.93703141	1.68148751	79.4584853	39.6719436	66.7078777	66.900573	1.002888645	1.00288865	
Jan-95	97	68.4297079	45.1992264	1.5139575	1.88583153	36.2862253	39.5964202	74.6721778	-6.24246992	-0.08359834	0.08359834	
Feb-95	98	43.8584054	44.5301328	0.98491522	1.55987266	28.1166575	39.5208968	61.6475666	-17.7891612	-0.28856226	0.28856226	
Mar-95	99	41.083926	44.0753989	0.93212829	1.14889704	35.7594498	39.4453735	45.3186729	-4.23474683	-0.09344375	0.09344375	
Apr-95	100	39.4013771	43.7516869	0.90056818	0.87120925	45.2260774	39.3698501	34.2993777	5.1019994	0.148749037	0.14874904	
May-95	101	32.8035534	43.1939509	0.75944786	0.74332677	44.1307306	39.2943267	29.2085249	3.59502846	0.12308148	0.12308148	
Jun-95	102	31.0761676	39.3118134	0.79050456	0.69866306	44.4794772	39.2188034	27.4007291	3.67543849	0.134136522	0.13413652	
Jul-95	103	20.2913087	35.3256178	0.57440775	0.58424909	34.730578	39.14328	22.8694258	-2.57811715	-0.11273205	0.11273205	
Aug-95	104	19.2021403	35.0990162	0.54708486	0.55634799	34.5146218	39.0677566	21.7352677	-2.53312738	-0.11654457	0.11654457	
Sep-95	105	21.9412811	35.5667908	0.6169036	0.59611973	36.8068361	38.9922333	23.2440395	-1.30275834	-0.05604699	0.05604699	
Oct-95	106	23.6712329	35.6126564	0.66468597	0.64909242	36.4682012	38.9167099	25.2605413	-1.58930846	-0.06291664	0.06291664	
Nov-95	107	38.1566912	35.1232331	1.08636614	1.02490295	37.2295652	38.8411865	39.8084466	-1.65175545	-0.04149259	0.04149259	
Dec-95	108	50.0434869	34.7376858	1.44061084	1.68148751	29.7614383	38.7656632	65.1839785	-15.1404916	-0.2322732	0.2322732	
Jan-96	109	56.3259789	34.8652724	1.61553245	1.88583153	29.8679802	38.6901398	72.9630856	-16.6371067	-0.22802088	0.22802088	
Feb-96	110	50.5236957	35.2115335	1.43486213	1.55987266	32.3896283	38.6146164	60.2338845	-9.71018879	-0.16120808	0.16120808	
Mar-96	111	45.6452253	35.4909893	1.28610744	1.14889704	39.7296047	38.5390931	44.27745	1.36777535	0.030891015	0.03089101	
Apr-96	112	35.9408517	35.8045813	1.00380595	0.87120925	41.2539831	38.4635697	33.5098178	2.43103394	0.072546916	0.07254692	
May-96	113	24.5179204	36.3442692	0.6746021	0.74332677	32.9840407	38.3880463	28.5348624	-4.01694201	-0.14077313	0.14077313	
Jun-96	114	30.1086657	37.0381394	0.81290978	0.69866306	43.0946869	38.312523	26.7675444	3.34112132	0.124819866	0.12481987	
Jul-96	115	24.3208882			0.58424909	41.6276011	38.2369996	22.3399323	1.98095586	0.088673315	0.08867331	
Aug-96	116	23.4828263			0.55634799	42.2088817	38.1614762	21.2310604	2.25176589	0.106059982	0.10605998	
Sep-96	117	24.3675348			0.59611973	40.8769139	38.0859529	22.7037878	1.66374691	0.073280587	0.07328059	
Oct-96	118	28.7711881			0.64909242	44.3252568	38.0104295	24.6722816	4.09890651	0.166134068	0.16613407	
Nov-96	119	46.0092447			1.02490295	44.8913184	37.9349061	38.8795972	7.12964751	0.183377608	0.18337761	
Dec-96	120	58.8438178			1.68148751	34.9950965	37.8593827	63.6600793	-4.81626148	-0.07565591	0.07565591	MAPE
Jan-97	121				1.88583153		37.7838594	71.2539934	-71.2539934	Sum =	12.0326637	0.1990272
Feb-97	122				1.55987266		37.708336	58.8202025	-58.8202025			
Mar-97	123				1.14889704		37.6328126	43.2362271	-43.2362271			
Apr-97	124				0.87120925		37.5572893	32.7202579	-32.7202579			
May-97	125				0.74332677		37.4817659	27.8612	-27.8612			
Jun-97	126				0.69866306		37.4062425	26.1343598	-26.1343598			
Jul-97	127				0.58424909		37.3307192	21.8104388	-21.8104388			
Aug-97	128				0.55634799		37.2551958	20.7268531	-20.7268531			
Sep-97	129				0.59611973		37.1796724	22.1635362	-22.1635362			
Oct-97	130				0.64909242		37.1041491	24.0840218	-24.0840218			
Nov-97	131				1.02490295		37.0286257	37.9507477	-37.9507477			
Dec-97	132				1.68148751		36.9531023	62.1361801	-62.1361801			
Jan-98	133				1.88583153		36.877579	69.5449012	-69.5449012			
Feb-98	134				1.55987266		36.8020556	57.4065205	-57.4065205			
Mar-98	135				1.14889704		36.7265322	42.1950042	-42.1950042			
Apr-98	136				0.87120925		36.6510089	31.930698	-31.930698			
May-98	137				0.74332677		36.5754855	27.1875375	-27.1875375			
Jun-98	138				0.69866306		36.4999621	25.5011751	-25.5011751			
Jul-98	139				0.58424909		36.4244388	21.2809453	-21.2809453			
Aug-98	140				0.55634799		36.3489154	20.2226458	-20.2226458			
Sep-98	141				0.59611973		36.273392	21.6232846	-21.6232846			
Oct-98	142				0.64909242		36.1978687	23.4957621	-23.4957621			
Nov-98	143				1.02490295		36.1223453	37.0218982	-37.0218982			
Dec-98	144				1.68148751		36.0468219	60.6122809	-60.6122809			

Seasonality Calculations													
Month/Year	87	88	89	90	91	92	93	94	95	96	Med Avg	Adj Avg
Jan		1.84860405	2.17442439	1.75192119	2.0770134	1.86724532	2.13931958	1.80783433	1.5138574	1.61553245	1.87052396	1.85582153
Feb		1.40991897	1.77451291	1.75789834	1.29282018	1.50766994	1.62570411	1.76286222	0.95491522	1.434862125	1.5472107	1.55987286
Mar		1.23014221	1.07784597	1.26397906	1.26856964	1.00378429	1.1113597	1.00993793	0.93212625	1.265107439	1.13857109	1.14969704
Apr		0.86319392	0.76306292	0.84127925	0.84958795	0.53136271	0.87857069	0.83707486	0.90056818	1.003905948	0.86413738	0.87130925
May		0.74819636	0.73468206	0.76952306	0.80973967	0.70227715	0.67088704	0.74186136	0.75944786	0.674602104	0.73729296	0.74332677
Jun		0.70777335	0.66087973	0.84513612	0.82373222	0.65556092	0.55277152	0.65024043	0.79050456	0.812804781	0.69299179	0.69856306
Jul	0.63733537	0.68205973	0.56348331	0.55319772	0.56313506	0.53000726	0.58460151	0.62184252	0.57440775		0.57950656	0.58424908
Aug	0.55535053	0.51232642	0.59733183	0.46398042	0.90983804	0.51585654	0.57614434	0.56825355	0.54708486		0.55183194	0.55634789
Sep	0.53815691	0.55236203	0.59280551	0.5276961	0.61680487	0.61571308	0.6671257	0.57871871	0.6189026		0.58129084	0.58611673
Oct	0.69375377	0.7086804	0.63986588	0.59485287	0.65440664	0.5753492	0.59643235	0.60983895	0.66468597		0.64382354	0.64909242
Nov	1.03534352	0.95886908	0.85214928	0.95405566	1.08058881	0.8700056	1.10801689	1.05406042	1.06536614		1.0165635	1.02490296
Dec	1.71201128	1.47258587	1.60355962	1.68684565	1.77976569	1.79691978	1.55700956	2.93703141	1.44061084		1.68783836	1.68148751
											11.9025923	12







APPENDIX H. ELECTRICITY AND GAS COSTS UNDER UHA CONCEPT

Electricity Costs under UHA concept

Month	Monterey	Marina	Difference	Average of two cities	Baseline Qtys	Above Baseline Qtys	Baseline Costs	Above Baseline Costs	Total Costs
Jan-97	447.976573	497.691407	-49.714835	472.8339898	275.9	196.9339898	31.974051	26.23357678	58.2076278
Feb-97	421.856832	454.821534	-32.964702	438.3391828	249.2	189.1391828	28.879788	25.19523054	54.0750185
Mar-97	385.46999	410.608785	-25.138796	398.0393874	275.9	122.1393874	31.974051	16.2701878	48.2442388
Apr-97	349.907285	384.719735	-34.81245	367.3135101	267	100.3135101	30.94263	13.36276268	44.3053927
May-97	334.165422	359.422814	-25.257392	346.7941179	238.7	108.0941179	27.662943	14.39921745	42.0621604
Jun-97	327.551932	377.878852	-50.32692	352.7153919	231	121.7153919	26.77059	16.21370736	42.9842974
Jul-97	315.985445	369.782878	-53.797434	342.8841615	238.7	104.1841615	27.662943	13.87837215	41.5413152
Aug-97	321.297101	365.789068	-44.491967	343.5430841	238.7	104.8430841	27.662943	13.96614724	41.6290902
Sep-97	336.353323	390.73497	-54.381647	363.5441468	231	132.5441468	26.77059	17.65620579	44.4267958
Oct-97	334.815424	376.288665	-41.473241	355.5520444	238.7	116.8520444	27.662943	15.56586083	43.2288038
Nov-97	389.621369	411.155417	-21.534047	400.388393	267	133.388393	30.94263	17.76866784	48.7112978
Dec-97	430.154455	475.842149	-45.687694	452.9983023	275.9	177.0983023	31.974051	23.59126485	55.5653158
Average	366.262929	406.228023	-39.965094	386.245476				Total Annual Cost	564.961354
								Average Monthly Cost	47.0817795

Gas Costs under UHA concept

Jan-97	68.8864176	71.2539934	-2.3675758	70.07020551	58.9	11.17020551	37.675974	9.645919263	47.3218933
Feb-97	59.6464907	58.8202025	0.82628823	59.23334661	53.2	6.033346609	34.029912	5.210036131	39.2399481
Mar-97	51.6694359	43.2362271	8.43320881	47.4528315	58.9	0	37.675974	0	37.675974
Apr-97	38.5973814	32.7202579	5.87712347	35.65881965	57	0	36.46062	0	36.46062
May-97	32.2136059	27.8612	4.35240599	30.03740295	21.7	8.337402953	13.880622	7.199680946	21.0803029
Jun-97	28.5126103	26.1343598	2.37825054	27.32348506	21	6.32348506	13.43286	5.460582289	18.8934423
Jul-97	23.8985687	21.8104388	2.08812986	22.85450375	21.7	1.154503754	13.880622	0.996960172	14.8775822
Aug-97	22.5966851	20.7268531	1.86983193	21.6617691	21.7	0	13.880622	0	13.880622
Sep-97	24.0672693	22.1635362	1.90373305	23.11540274	21	2.115402738	13.43286	1.82673488	15.2595949
Oct-97	26.7521792	24.0840218	2.6681574	25.41810055	21.7	3.718100546	13.880622	3.210728545	17.0913505
Nov-97	42.5173109	37.9507477	4.56656319	40.2340293	57	0	36.46062	0	36.46062
Dec-97	61.4002474	62.1361801	-0.7359327	61.76821372	58.9	2.868213721	37.675974	2.476817277	40.1527913
Average	40.0631835	37.4081682	2.65501533	38.73587587				Total Annual Cost	338.384742
								Average Monthly Cost	28.1995618

Electric chages are calculated by determining the baseline usage rate at 7.7kWhs during the summer and 8.9 kWhs for winter
Electric costs associated with baseline quantities are $0.11589 for baseline or below and $0.13321 for above baseline

Gas charges are calculated by determinng the baseline usage rate at .7 therms during summer and 1.9 therms during winter.
Gas costs associated with baseline quantites are $.63966 for baseline or below and $.86354 for above baseline quantities.
PG&E considers summer from May 1st through October 31.

APPENDIX I. LA MESA CURRENT ELECTRICITY AND GAS CHARGE BASED ON HISTORICAL CONSUMPTION WITH NO INCENTIVE PROGRAM

La Mesa Village Current Electricity Charge Based on historical consumption with no incentive program						
Month	LMV	Baseline Qtys'	Above Baseline Qtys	Baseline Costs	Above Baseline Costs	Total Costs
Jan-97	893.047835					61.6203006
Feb-97	890.280023					61.4293216
Mar-97	905.599625					62.4863741
Apr-97	815.951424					56.3006483
May-97	795.298067					54.8755666
Jun-97	805.429148					55.5746112
Jul-97	711.779477					49.1127839
Aug-97	743.505167					51.3018565
Sep-97	820.903436					56.6423371
Oct-97	810.656733					55.9353146
Nov-97	848.390084					58.5389158
Dec-97	949.790133					65.5355192
Average	832.552598				Total Annual Cost	669.35355
					Average Month Cost	57.4461291

La Mesa Village Current Gas Charge Based on historical consumption with no incentive program						
Jan-97	73.5880884	43.4	30.18808837	27.761244	26.06862183	53.8298658
Feb-97	73.2337376	39.2	34.03373757	25.074672	29.38949374	54.4641657
Mar-97	72.8793868	43.4	29.47938678	27.761244	25.45662966	53.2178737
Apr-97	72.525036	42	30.52503598	26.86572	26.35958957	53.2253096
May-97	72.1706852	21.7	50.47068518	13.880622	43.58345548	57.4640775
Jun-97	71.8163344	21	50.81633439	13.43286	43.8819374	57.3147974
Jul-97	71.4619836	21.7	49.76198359	13.880622	42.97146331	56.8520853
Aug-97	71.1076328	21.7	49.40763279	13.880622	42.66546722	56.5460892
Sep-97	70.753282	21	49.753282	13.43286	42.96394914	56.3968091
Oct-97	70.3989312	21.7	48.6989312	13.880622	42.05347505	55.934097
Nov-97	70.0445804	42	28.0445804	26.86572	24.21761696	51.083337
Dec-97	69.6902296	43.4	26.29022961	27.761244	22.70266488	50.4639089
Average	71.639159				Total Annual Cost	656.792416
					Average Monthly Cost	54.7327014

Electric charges are under a special schedule negotiated by the Navy, therefore the average cost per kWh is 0.069

Gas charges are calculated by determining baseline usage rate at .7 therms during summer and 1.4 therms during winter.

Gas costs associated with baseline quantities are .63966 for baseline quantities or below and .86354 for above baseline quantities.

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